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FAO — The Food and Agriculture Organization of the United Nations — grew out of a United Nations Conference held at Hot Springs, Virginia, U.S.A., in May 1943. The nations agreed to work together to secure a lasting peace through freedom from want. The Organization was formally founded at Quebec, Canada, in October 1945. It was located at Washington D.C. until 1951 when the Headquarters office was moved to Rome.

Unasylva is prepared by the Forestry and Forest Products Division, directed by Mr. Egon Glesinger, and published every quarter in English, French and Spanish. It attempts to cover a range of interest which is as wide as that of the Division whose work it mirrors. Signed articles express the opinions of the authors and do not necessarily represent the views of the Organization. All material in ***Unasylva*** may be freely reprinted, but acknowledgment is requested, together with a copy of the publication containing the reprint.

Cover photograph. *The special commemorative stamp honoring the Fifth World Forestry Congress, issued by the Postal Administration of the United Nations. First day issues on sale in New York and Seattle on 29 August. Foresters everywhere are grateful to the Secretary-General of the United Nations, Mr Dag Hammarskjold, for this signal tribute to forestry.*

Unasylva

An International Review of Forestry and Forest Products

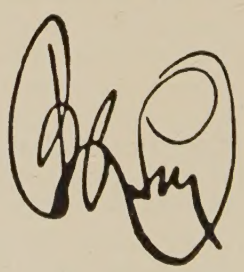
MESSAGE OF THE DIRECTOR-GENERAL, FAO

THE Fifth World Forestry Congress to be held this year in Seattle is an important event, and it is appropriate that a special issue of *Unasylva* should be brought out to mark the occasion.

The main theme of this session of the World Forestry Congress is " The Multiple Use of Forest and Associated Lands ". As the title implies, the Congress will pay attention not only to the technical problems connected with the utilization of forests and forest products, but also to the broader issues of land and water development as a whole in the context of the world's total resources.

In the past, there was a tendency to regard the aims of conservation and utilization of forests as disparate. However, there can be disparity only between the extreme forms of conservation and utilization — that is, between " hoarding " and " mining ". In recent times, a more rational and dynamic view, in which the dual role of the forester as conservator and producer is recognized, has emerged. The forester is being increasingly called upon to match forest production with the needs of an expanding economy without sacrificing the long-term interest of maintaining the output potential intact. Science and technology are placing in the hands of foresters new means of harmonizing these immediate and long-term interests of society, and are opening up new approaches to a rational policy through increased emphasis on ecological studies. The relationship between forests and other forms of land use should be studied more intensively, thus opening the way for maximum development of the output potential.

FAO has always regarded forestry as a very important part of its activities, because forests are an essential factor, sometimes the very basis, of building up food-growing capacity and industrial development in many parts of the world. FAO has been giving special attention to the problems of forestry and land use in the less developed countries — problems which must be solved if the living standards of the peoples of these regions are to be raised. I am sure this issue of *Unasylva* will focus the attention of foresters, scientists and development planners on some of the vital problems confronting policy-makers today, and thus contribute to their solution through coordinated national and international action.



B. R. SEN
DIRECTOR-GENERAL

EGON GLESINGER, *Director of the Forestry and Forest Products Division of FAO, surrounded by some of the top members of the divisional staff at Rome Headquarters. Regional offices are maintained in Santiago (Chile), Rio de Janeiro (Brazil), Mexico City (Mexico), Accra (Ghana), Cairo (U.A.R.), Bangkok (Thailand), and Geneva (Switzerland). In addition, some 60 officers are serving in individual countries throughout the world under FAO's technical assistance program and on projects of the United Nations Special Fund for Economic Development.*

Front row: T. FRANÇOIS, *standing (Chief, Forest Policy Branch);* SIR HENRY BERESFORD-PEIRSE *(Deputy Director);* EGON GLESINGER *(Director);* L. J. VERNELL *(Chief, Program and Operations Office);* A. MÉTRO *(Chief, Forest Technology Branch);* J. WESTOBY *(Chief, Forest Economics Branch).*

Second row: M. A. HUBERMAN, L. GIMENEZ-QUINTANA, N. DE FELSOEVANYI, J. VINZANT, J. M. YAVORSKY.

Back row: A. SUNDELIN, O. FUGALLI, R. G. FONTAINE, H. REICHARDT.

The Role of Forestry in World Economic Development

Egon Glesinger

Director, Forestry and Forest Products Division, FAO [1]

In 1960 the world's forests will yield some 1,700 million cubic meters of roundwood. This volume, by weight around 1,350 million tons, may be compared with a world production of all grains of 800 million tons or a world steel output of 290 million tons.

The output of primary forest products will be worth about 35 billion dollars — the same order of magnitude as the national incomes of countries like France, Germany or the United Kingdom, and roughly one fourth of the estimated value of world food production. Primary forest industries will employ something like five million people, secondary industries as many again. Five to six million people will be engaged on felling and extraction and about 1.5 million in growing and tending forests. Thus forestry and forest industries will be affording employment to 17 or 18 million people, quite apart from the incomes which many millions of farmers will be getting from their woodlots, or communities be gaining from their communal woodlands.

There is no doubt that forestry represents a significant element in world economy. The next question is obviously whether it is going to become *more* or *less* important in the future. What should we be planning for, looking 20 or 40 years ahead? Will forests still have an essential role to play in the world's further economic development?

The dangers of human progress

Throughout recorded history the earth's forest area has been shrinking. It has shrunk more quickly in the last 100 years than ever before. Some people held, even a few decades ago, that this was a necessary accompaniment of economic and social progress. To early man the forest afforded food, fuel and shelter. With the advent of settled agriculture and population expansion, tremendous areas were cleared. The early stages of industrialization brought new demands on the forest — for constructional wood and fuel on an ever more lavish scale — and the forest boundaries receded as man progressed and multiplied.

The world's forests are still being destroyed, wilfully or ignorantly. But at the same time the realization is spreading that the diminution of forest areas may have far-reaching consequences because forests provide not just wood but a host of other benefits or " human utilities ".

In his keynote address, Dr. McArdle has spoken fully on the concept of the multiple use of forest lands and Dr. Sen, the Director-General of FAO, has also stressed how the need to conserve forests and soils lies at the base of much of our thinking in FAO.

I might therefore restrict myself to a reminder that the benefits from forests are essentially twofold, on the one hand wood, and on the other various physical and social effects frequently termed " forest influences ". In many instances the latter transcend in importance the significance of forests as producers of wood. Indeed, over much of the earth's surface forests and associated vegetation are the protecting covers which secure the maximum absorption of rainfall. regulate streamflow, help prevent flooding and silting, Thus they improve the efficiency with which water resources are used for almost all of man's activities — irrigation, domestic water supplies, industry, hydroelectric works, to mention but a few. The quantity of water needed every day by modern cities and industry is enormous, yet it is seldom realized what a large part forests play in the complicated process of ensuring steady supplies.

Then, again, forests give protection against erosion, and shelter to agriculture in adjoining areas. They can act as barriers against landfalls and avalanches, they can furnish fodder and grazing for livestock and a habitat for wildlife, they provide places for public recreation, and surroundings for rest and the restoration of health — as well as contributing to the beauty of the landscape.

The trouble is that while almost everyone accepts in theory the indispensable role of the forest in all these connections, yet governments, economists and planners conveniently forget about it and assign to forest investment far lower priority than it deserves, because foresters have not yet succeeded in measuring the value of these " influences " in monetary terms. The studies made in connection with FAO's Mediterranean Development Project produced many striking illustrations of the catastrophic consequences which threaten a large number of countries as a result of inadequate provision

[1] Address delivered at the Fifth World Forestry Congress, 1960

of funds and priorities for the restoration and maintenance of a proper forest cover for protective purposes.

Let me reassure you that, by recognizing the many purposes of the forest and acknowledging the multiple use concept, we do not mean that there should be equal division of forest lands among all possible uses or all uses on every hectare. What we do mean is that, in defending our forest resources against competing claims for land, we must weigh any one exclusive use against a possible combination of uses, with the idea of getting the optimum combination in a given management unit. The forest will not necessarily yield maximum production for any one of the uses selected, but the total benefits will probably be greater than could be obtained by exclusive use for one purpose.

We all know very well that there is scarcely a country in the world where one does not find substantial areas which should be covered by forests — areas which are at present either used for cultivation or grazing or have become denuded and unproductive. Moreover, with the growth of world population and the inevitable rise in living standards particularly of the underdeveloped countries, the areas needed to be reserved for tree cover or where productive forests have to be restored are bound to grow. It is one of the important responsibilities of foresters, economists and statesmen to see to it that the maintenance or establishment of forests in critical areas becomes accepted as an indispensable aspect of all national programs for economic and social development. This process must go hand in hand with increased food production and be complementary to it.

Wood consumption trends

Let us now turn to the second aspect of our question about the future role of forestry and examine world trends in the consumption and production of wood. One of the first facts which comes to mind is that technical progress has resulted in a steady displacement of wood in uses for which at one time it was the only conceivable material. *Per caput* consumption of fuelwood in Europe has fallen from 0.42 cubic meters in 1913 to 0.24 cubic meters in 1955, and this process continues because it is an expression of progress. Before the last war the average dwelling unit in Europe needed nearly 15 cubic meters of wood. In 1950, 10.5 cubic meters. In 1955, only 7.5 cubic meters. In the United States, between 1940 and 1953, the wood requirements for a dwelling unit fell from 33 cubic meters to under 25 cubic meters.

Does all this mean that the " age of wood " is slowly passing?

The answer is emphatically NO. This is not only my personal conviction as the author of a book which tried to demonstrate that wood and forests will be called upon to play an increasing role. It is supported by considerable evidence.

First, despite substitution, *per caput* consumption of industrial wood has risen over the last decade in nearly every region of the world. The following figures, all in cubic meters *per 1,000 capita,* are illustrative: Europe, from 390 to 500; South America, 150 to 240; Africa, 40 to 50; Asia, 50 to 90; Oceania, 930 to 1,170; only in North America is there no clear evidence of a rise: the world average has risen by one fourth from 350 to 440. While world population has risen by 20 percent, total world consumption of industrial wood has risen from 690 million cubic meters to 920 million cubic meters, or by 33 percent over the decade. Secondly, there is a positive correlation between consumption of industrial wood and national income. It is not a high correlation, because wood availability (either in the shape of domestic supplies or capacity to import) is also a big factor. Moreover, FAO investigations have shown that, while the response of consumption to increases in income is very high at low income levels, it becomes progressively less marked as income rises. In countries with national incomes below $100 per head, the elasticity of demand for newsprint, for instance, lies between 2.5 and 3; it falls to around 1.5 at incomes of $400 to $600 per head; and approaches 1.0 at incomes of over $1,000 per head. For other paper and board categories the fall is steeper, and at the highest levels of income as in the United States of America and Scandinavia, elasticity for certain categories seems to fall below 1.0 That is, a given percentage rise in income brings a less than proportionate rise in demand.

But, despite this flattening of the curve, the correlation between rises in income and in the consumption of industrial wood remains a basic fact of the greatest importance. Of the 11 countries enjoying the highest *per caput* income not a single one consumes less than 500 cubic meters of industrial wood per 1,000 capita. Six of them, in fact, consume more than 1,500 cubic meters per thousand. But at the other end of the scale, of the 20 or so low income countries for which *per caput* income estimates are available, and all of them with a *per caput* income of less than $100, not a single one consumes even as much as 100 cubic meters *per 1,000 capita* and only five consume more than 50 cubic meters per thousand.

We must of course be careful not to say that as the presently low income countries move up the income scale to the level of the more advanced countries, they will necessarily need to consume as much industrial wood per head as do, say, Japan, Canada and the United States today. But it is a fair generalization that no low income country will reach higher levels while maintaining low wood consumption levels. In other words, no underdeveloped country, intent on realizing economic growth, is likely to move into the middle income level, let alone the high income level, without requiring substantially greater quantities of industrial wood *per caput* than the meager amounts they consume today. One of the major reasons for this will be the rise in educational needs which are at the basis of economic progress, and the requirements will be multiplied by population growth.

This conclusion is amply confirmed by studies which

FAO has just completed on future timber needs in the Asia-Pacific region. Professor Streyffert of Sweden, in his well-known book, *World Timber Trends and Prospects*, gives the same answer.

I do not want to dwell unduly on this theme, still less to numb you with strings of figures. I have said enough, I hope, to explain my belief that, between now and the end of the century, the world will want substantially greater quantities of industrial wood from its forests. How much more would be a hazardous guess pending the completion of what FAO calls its Timber Trends Studies, which we hope to complete for all regions of the world in time to present a sound answer to the next World Forestry Congress.

Meanwhile, I personally would guess that the world will need at least twice as much industrial wood as it consumes today by the end of the century and probably earlier, some time between 1980 and 1990. We can also conclude from FAO's present knowledge that needs will rise relatively fast in the less advanced areas of the world; and that for low income countries, that is for more than half of humanity, a substantial increase in wood consumption will be an essential accompaniment of and indeed a condition of economic growth.

The slow rise in output and its reasons

In the light of what I have said on wood consumption trends, can we be satisfied with the progress that has been made in forestry over the last decade?

Unfortunately, I do not think we can. Forest output has been lagging behind the progress of national incomes. Between 1950 and 1957, the gross national product of industrialized and underdeveloped countries has risen by close on 30 percent but the output of the world's forests by not much more than 15 percent. For industrial wood alone, the picture is slightly better, a rise of nearly 30 percent, but part of the increase has been provided by shifts from fuelwood to pulpwood and by better utilization of previously waste materials. But there is an obvious limit to such shifts and in many countries this limit has been reached. Moreover, there is the same trouble as in agriculture, that the biggest increases have on the whole been in the already developed countries and in the U.S.S.R., and least in the underdeveloped countries where production might almost be said to have been stagnant. This defect mars even more what would otherwise be the brightest spot on the production side, namely the growth of pulp and paper industries. In the past 20 years, world capacity has risen from 25 to 60 million tons of paper. This increase has proceeded substantially faster than the simultaneous growth in world industrial output and has made pulp and paper an industry which by value (15,000 million dollars), size and capital is fully in line with the traditional large-scale industries of former days such as iron and steel, textiles, and oil. Yet, despite some recent progress in Latin America and the Far East, 90 percent of all the world's pulp is still produced in Europe and North America. And the growth of paper consumption for education purposes and packing in the poorer countries is being delayed by inadequate local supplies and the inability of these underdeveloped countries to allocate substantial amounts of foreign currencies for paper imports.

There are many reasons that explain this development, which is all the more disappointing since one would normally expect that the existence of enormous unexploited forest reserves would render an expansion in output particularly easy. Most of these reasons are well known and I would, therefore, like to deal only with some aspects which have emerged as particularly significant from our systematic observation of similar developments in some 80 to 100 countries all over the world.

1. It cannot be overstressed that governments, legislators and administrators still fail to appreciate fully the importance of forest development and conservation with the result that investments are insufficient, forest services understaffed and politically weak, and private capital not attracted even where forest development would be profitable.
2. Planners and economists often tend to give low priority to forest development as our experience in FAO has unhappily proved, because they believe that trees must always take 100 years to grow and are low-yielding, long-term investments. They overlook the fact that quick-growing plantations can reduce the growth cycle to 10 to 20 years especially for the supply of pulpwood and fuelwood, and they fail to appreciate that forest development usually starts with natural forests which, unlike agricultural crops, do not have to be grown, but only need to be made accessible, put under management, and cut.
3. Population pressures often combined with political expediency are another major reason why little priority is accorded to the conservation and maintenance of existing forests or to the establishment of new ones. The inability to put a value in economic terms on the protective benefits that come from the forests, contributes very significantly to this situation. The underfed half of the world population can hardly be expected to correlate food production and forestry if even their leaders and many technical specialists do not understand or are unable to demonstrate that connection. It was one of the main purposes of FAO's Mediterranean Development Project — which started out as a forestry program — to demonstrate how wrong it is to base national economic policies and development programs exclusively on short-term considerations and the need to secure quick returns. The programs drawn up in detail for 10 Mediterranean countries and for the region as a whole, constitute a deliberate attempt to combine long-term investments with short-term action and to show that such a policy may provide the answer which so many underdeveloped countries are looking for in

their attempts to achieve self-sustained growth. But, as yet, these FAO-prepared programs are still mainly on paper and we still are far from widespread acceptance of the need to plan development with due regard to long-term needs.

4. A further difficulty we encounter in some parts of the world is that governments tend to go from one extreme to the other — from no control whatever to complete prohibition of any kind of forest cutting and industrial development in the belief that such action is the best way to prevent forest destruction. I need not stress that such measures are almost as misguided as doing nothing. I regard it as one of our important educational tasks to spread understanding for the need to combine conservation and cutting restrictions in some areas, with commercial cutting and forest development in others.

5. Then there is the fact that most of the forests of the underdeveloped countries, where output should have risen, are tropical forests, often believed to be difficult of access. FAO's experience in its technical assistance program, for instance in the Amazon region, has shown these forests generally to be poor in presently commercially valuable species but not nearly so difficult of access as is generally imagined. But development must often await lamentably slow colonization and agricultural settlement; and there is little to attract investors during this process. A different picture of what can happen is provided by the eastern forests of Russia, also difficult of access and remote but, of course, of softwood. Their rapid present development is perhaps comparable to what happened in North America a century ago. Neither of these cases, however, provides a solution, and even less a much needed large-scale demonstration of converting tropical forests into real centers of forest operations and industries.

6. The biggest difficulty of all, however, stems in my opinion from the fact that in large parts of the world foresters have become accustomed to organize forest output almost exclusively in accordance with their views about the capacity of the resource and with little or no thought to present or prospective national needs. I have often been surprised to find that although planning is an indispensable element of all forest management and should therefore be highly developed among foresters, there are only a few countries where forest production is organized and planned in accordance with modern economic concepts. The establishment of steel mills or any other industry has always been determined by demand for the products. Foresters, however, have not yet adopted this approach and there still exist in fact many foresters who regard themselves as " conservators only ". There is no doubt that one of the basic responsibilities of foresters is the maintenance or building-up of the fertility and productivity of the soil. But this should not lead to such a slavish attachment to the conception of sustained yield (especially in the tropics, where yield is often extremely low) as to preclude the adoption of management plans designed to yield in quality and in quantity what industry and the consumers need. As was recently said by a distinguished European forester: " Silviculture must be the handmaid, and not the expensive mistress, of management ".

We are thus led to the conclusion that for a number of well-known reasons forest output, especially in the underdeveloped regions, is not progressing at the rate which appears desirable and even needed. Unless this situation is changed and the tempo of forest expansion greatly stepped-up, many countries of the world are bound to experience three equally serious difficulties in their development process. These are, first, that inadequate supplies of paper, building timber and other forest products will act as a real bottleneck in achieving better living standards and rising national incomes; secondly, that even the artificially reduced amounts of paper, timber, and so on, which still have to be imported will act as an increasingly serious drain on currency reserves which should be directed instead to the purchase of capital goods; and thirdly, that this growing and somewhat artificial shortage of forest products will lead to increasing overexploitation and destruction of accessible forests.

Signs of hope

Fortunately, the picture is not only one of unresolved difficulties. Indeed some of the basic obstacles which have impeded forestry progress are beginning to be removed.

(*a*) The most important development is perhaps the trend towards establishing plantations of quick-growing species. This is a development in the forestry field, if continued on a sufficient scale, comparable to the transition in agriculture to selected strains and hybrids in crop cultivation. There is the possibility of obtaining three, five or ten times the yield per hectare as is obtained from natural forests. This leads some people to advocate the sweeping removal of mixed tropical hardwood forests and their replacement by new plantations, a subject which provides a perennial topic for argument amongst foresters.

(*b*) Of parallel importance, especially for developed countries where labor costs are high and there is full employment, is the progress of modern logging techniques. We can compare the mechanization of forest operations, and other improvements in working techniques, with the revolution which the introduction of tractors, harvesters, and other machinery a generation ago brought to agriculture. In underdeveloped countries, these techniques can fundamentally change the notion of forest accessibility and help reduce the almost prohibitive costs which primitive logging methods entail today.

(*c*) Technical progress is producing every day new practical demonstrations of the dictum that wood is a most versatile raw material. Timber industries are using much ingenuity and enterprise in taking advantage of what wood has to offer. But more can be done, not only in devising new uses for wood and perfecting manufacturing techniques, but in the "art of selling" where I often think we lag behind other industries. Wood chemistry is as yet in its infancy, and a break-through is overdue and is perhaps in sight in the use of lignin, which forms some 30 percent of the dry weight of wood. Pulp and paper capacity is spreading and the rate of progress is accelerating in the less developed parts of the world.

(*d*) Despite the difficulties experienced at high levels of government and economic planning to which I referred earlier, some statesmen and administrations are beginning to realize that forestry can provide a ready basis for industrial and economic development. Progress is slow, because of lack of experience in planning, lack of technical services — though the picture in regard to forest services, while still fairly dismal, is greatly improved from ten years ago — and lack of capital. But there are glimmerings that forest development, integrated with agricultural and industrial progress, will come to be used deliberately as an essential part of measures to promote a self-sustaining economic growth, and often as a particularly useful form of public works capable of absorbing unemployed and underemployed rural manpower.

(*e*) The impact of these more encouraging developments has reached the point where it can be clearly discerned. Maybe the most important example is provided by Europe, where FAO's first regional Timber Trends Study, published in 1953, revealed the danger of a serious pulpwood deficit and urged the adoption of immediate measures to step up forest output. Despite doubts voiced at the time, foresters have been able to meet the challenge and not only are production figures, by 1960, up to the level of our most optimistic projections, but there are also indications in many countries that further stepping-up of output can be expected. Europe, moreover, is one of the regions where, together with the United States and apparently also in Mainland China, the area of forests is on the increase. It is also reasonable to hope that an intensification of forestry activities stimulated by FAO's Mediterranean Development Project will lead to a substantial restoration of forests not only in Southern Europe but also in the Near East and North Africa.

(*f*) Finally, although we in FAO are not too satisfied with the practical achievements to date, we are still rather proud to have seen established seven Regional Forestry Commissions, which among them cover the entire membership of FAO, and which provide machinery for planning concerted action to achieve the changes which in our opinion are necessary.

Tasks for the future

I have tried in the course of this address to touch on some of the problems we are facing. What I would like to convey to this distinguished Congress, is that there is an urgent need to step-up very substantially and on a continuing basis, the rate at which the world's forest output is growing, and also to increase the area on which forests are restored or maintained in order to exercise their protective influence. These objectives can and must be reached, and it is my belief that this Congress could render an important service by drawing attention to the four central tasks towards which foresters should, during the next years, devote attention. These are:

1. Systematic studies to develop methods for evaluating forest influences in quantitative terms. These, I believe, will provide support for forestry claims for investment funds in competition with claims from other sectors.

2. Research and experiment with quick-growing species for all climates, with special attention to the introduction of plantations in tropical areas as a means of harnessing at last the vast reserves constituted by tropical forest lands.

3. A gradual spreading of pulp and other forest industries, in order to create in the major underdeveloped regions centers of forest operations and industries corresponding to their forest wealth and in line with their growing needs for forest products.

4. The systematic adoption of quantitative national plans for forest production and development related to prospective requirements for forest products. This approach should become the standard basis for forest policies in every country.

Let me conclude by calling on you, ladies and gentlemen, to help the nations of the world derive ever-growing benefits from the world's forests. Wood has an enormous function to fulfil in a rapidly expanding world economy, and the world will be the poorer if its forests are not made to meet the requirements for paper, packaging, building materials, and the many other things which wood can provide.

And in the process of producing wood or providing shelter, the beauty of the world can be enhanced, and the lot of those who live in and on the forest and process its products, can be made happier and healthier.

The United States Timber Situation

R. C. Wilson
Chief, Forest Survey Branch, and
George Vitas
Forestry Information Specialist, Forest Service, United States Department of Agriculture

The United States is fortunate in having supplies of timber sufficient to support large and diverse forest industries. Timber products in the United States comprise about one fourth of all raw materials used for manufacturing and for construction. Nearly 80 cubic feet of wood products, or more than 2 cubic meters, is used by the average American each year.

America's rapidly expanding population — which is likely to double before the end of the century — is making increasing claims on its forest, not only for greater wood production but also for nontimber uses of the forest such as recreation and water. Moreover, substantial withdrawals of timber land for such purposes as highways, reservoirs and agriculture are in prospect. Thus American foresters face a real challenge in continuing to supply in the years ahead enough wood of the right quality at reasonable prices and enough other forest services to meet potential demands much larger than those of today.

For a closer look at the timber situation in the nation that is host to this year's World Forestry Congress, attention should be directed to some of the details revealed by a recent appraisal of America's timberlands (1) and the latest results of the comprehensive forest survey conducted by the United States Forest Service in co-operation with state agencies and forest industries.

Relation to World Timber Situation

The United States of America has eight percent of the forested area of the world — some 770 million acres (312 million hectares). Fourteen percent of the world's growing stock (including 18 percent of the softwood growing stock) is in the United States. This country cuts about one fifth of the timber removed from the world's forests. Although some forest products are exported, most of this cut is for domestic consumption. The United States also imports more forest products than she exports. Imports are primarily softwood lumber, newsprint paper, wood pulp and pulpwood (2).

Wide Variety of Forests

One third of the United States is forest land. The forests are extremely variable in character, since more than 800 native tree species (and a number of exotics) occur within the country. These grow under a wide range of conditions.

Northern and southern limits of forests: from stunted spruce to lush hardwoods

At America's northern limits of forest in the State of Alaska most of the trees are stunted white and black spruces (*Picea glauca* and *P. mariana*), paper birch (*Betula papyrifera*) and willows (*Salix* spp.) growing on permafrost. In contrast, trees near the southern limits of forest are baldcypress (*Taxodium distichum*) and various subtropical hardwoods forming a luxuriant canopy over the swamps in the states of Louisiana, Mississippi and Florida.

Western and eastern limits: from tropical hardwood to temperate pines

The western limits of America's forest in the island State of Hawaii, where koa (*Acacia koa*), ohia (*Metrosideras polymorpha*) and other tropical hardwoods cling to the lava, contrast with the eastern limits where clumps of pitch pine (*Pinus rigida*) accent the low sand dunes of the Atlantic Ocean shoreline.

Contrasts in adjacent forests

Hardly less striking are contrasts in forest types growing in much closer proximity. In the State of California, for example, dense and towering stands of redwood (*Sequoia sempervirens*), with per acre timber volumes greater than those of any other forest in the world, blanket the moist seaward slopes of a mountain range. In contrast, scrubby stands of chaparral (including species of *Ceanothus*, *Cercocarpus* and *Arctostaphylos*), valuable mainly as protective forest for the watershed, shield the sunbaked interior slopes of the same mountains.

The State of Montana, sitting astride the continental divide of the Rocky Mountains, offers another contrasting example. West of the divide are extensive reaches of pure conifers — pine, spruce, fir and larch — characteristic of the western mountain states. But immediately east of the divide — where the plains begin that stretch across mid-continent to the Appalachian

FIGURE 1. – *Most of the timberlands are in coastal sections of the United States. Alaska contains the most acreage of commercial forest, and the smallest acreages are in the prairie states near the center of the country. The shading indicates the major locations of the 530 million acres (214 million hectares) of commercial forest. The number shown in each state represents the area of commercial forest land therein in millions of acres.*

mountains — are only patches of forest. These are mainly cottonwoods (*Populus* spp.) and other native hardwoods strung out along the water courses.

Commercial Forests Two Thirds of Total

Two thirds of the forest, or 520 million acres (215 million hectares), is commercial timberland; that is, it will produce, or is physically capable of producing, industrial wood and is not reserved from cutting. The other 240 million acres (97 million hectares) are classed as noncommercial forests, either because they are too unproductive to manage for wood production or because they are reserved in the public interest for recreation, watershed protection or other paramount values. The national parks are examples of such reservations.

Timberlands mainly near the coast

Most of the timberlands are in coastal states, although every one of the 50 states in the Union has at least small acreages of commercial forest (Figure 1). One fifth of the commercial area lies within the four Pacific Coast states of Alaska, Washington, Oregon and California. Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*) and several species of spruce (*Picea*) and hemlock (*Tsuga*) are the most valuable components of the timberlands in those states. Another fifth of the commercial timberland is within the five southern states of Louisiana, Mississippi, Alabama, Georgia and Florida. Several species of pines — Loblolly pine (*Pinus taeda*), Longleaf pine (*P. palustris*), Slash pine (*P. caribaea*), Shortleaf pine (*P. echinata*) — and intermingled hardwoods are important components of the forests in the South.

Two Thirds of Growing Stock is Softwood

The commercial area supports about 550,000 million cubic feet (15,600 million cubic meters) of growing stock, in trees which are 5 inches (12.7 centimeters) or larger in diameter and meet merchantability specifications for wood products. Two thirds of the growing stock volume is in softwoods, primarily Douglas fir, pines, spruces, firs, and hemlocks. Most of the volume of hardwood growing stock is in oaks, mainly white and red oaks (*Quercus alba*, *Q. prinis*, *Q. borealis*, *Q. falcata* var. *pagodaefolia* and *Q. shumardii*). Nearly half of the nation's growing stock, or 260,000 million cubic feet (7.4 billion cubic meters) is in the four Pacific Coast states. About one third of this is one species, Douglas fir.

FIGURE 2. – *In the western United States are vast acreages of virgin forest. Here is part of the State of Oregon's timber wealth of old-growth Douglas fir* (Pseudotsuga menziesii). *Stands such as those in the foreground contain trees over 200 feet (60 meters) in height and more than 6 feet (1.8 meters) in diameter which are valued for high-quality veneer and lumber. Note that these forests are logged by clear cutting areas, each about 30 to 50 acres (12 to 20 hectares) in size, which are separated by reserve stands of timber. This procedure favors rapid natural regeneration — seedbed in mineral soil with competing vegetation removed and adjacent timber to provide the seed source. It also lessens the chance of windthrow of the reserve stands until the loggers return after a few years for that harvest.*

Nearly 10,000 million cubic meters of sawtimber

A supply of more than 2,000,000 million board feet of live sawtimber [1] (nearly 10,000 million cubic meters of roundwood) is standing in America's forests. Three quarters of this supply is softwood, of which Douglas-fir sawtimber constitutes approximately one quarter of the total. The largest concentration of this sawtimber volume is in the old-growth stand of the State of Oregon (Figure 2).

[1] Net volume of live sawtimber in board feet, International ¼-inch rule, in live trees of commercial species, containing at least one merchantable saw log with the following minimum diameters at breast height: eastern softwoods, 9 inches (22.9 centimeters); western softwoods and all hardwoods, 11 inches (27.9 centimeters).

FIGURE 3. – *Chart to represent the division of ownership of commercial forests in the United States.*

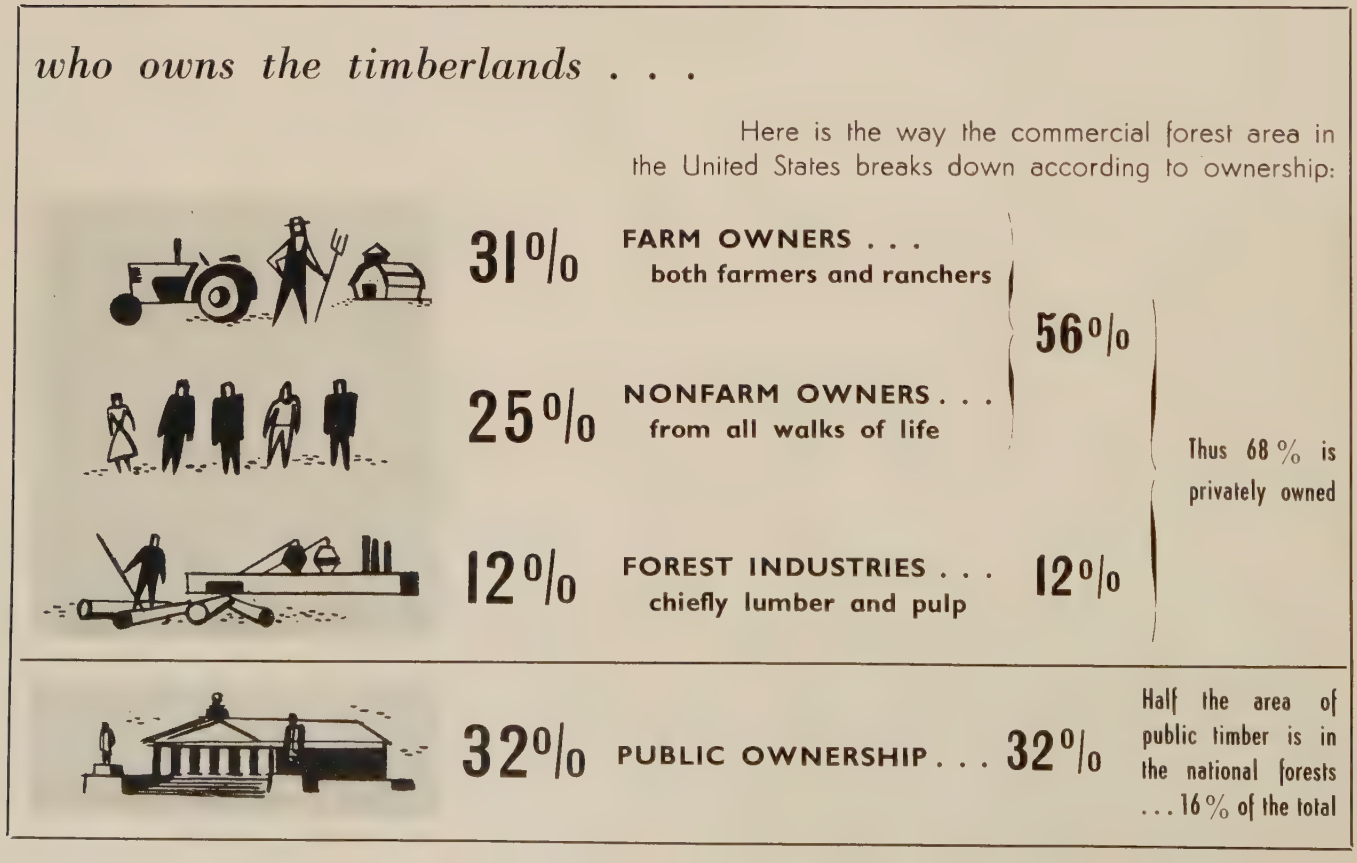

who owns the timberlands . . .
Here is the way the commercial forest area in the United States breaks down according to ownership:
31%
FARM OWNERS . . . both farmers and ranchers
25%
NONFARM OWNERS . . . from all walks of life
56%
12%
FOREST INDUSTRIES . . . chiefly lumber and pulp
12%
Thus 68 % is privately owned
32%
PUBLIC OWNERSHIP . . . 32%
Half the area of public timber is in the national forests . . . 16 % of the total

FIGURE 4. – *Nearly one third of the timberland in the United States is owned by farmers. Most of the farm holdings are in small woodlots held by more than three million different owners. Most of the ownerships are in the eastern states. The woods shown here (State of Iowa) are mainly oaks* (Quercus spp.) *and hickories* (Carya spp.) *with a scattering of other hardwoods such as American elm* (Ulmus americana) *and black walnut* (Juglans nigra). *Under forest management these trees, and a variety of other species growing on farm woodlands, offer good opportunities to landowners for supplementing their main source of income from agriculture. At the same time, they provide farmers with forest products for their home use.*

Ownership of Timberland

Mostly private holdings

Nearly 70 percent of the commercial timberland area is in private ownership (Figure 3). Farm holdings represent the largest class of owners, controlling approximately 31 percent of the timberland (Figure 4). Twenty-five percent is held by a variety of miscellaneous private owners — businessmen, professional people and housewives, for example — who are not directly associated with either agriculture or forest industries. There are four and a half million individual ownerships in these two classes. More than three million of these are farm holdings. There are also about 23,000 industrial owners (those engaged in the manufacture of lumber, pulp or other wood products) who hold 12 percent of the commercial forest area.

Small forests, of less than 100 acres (approximately 40 hectares) each, comprise 86 percent of the total number of private ownerships (3).

National government controls most of public timberlands

Most of the 32 percent of commercial forest lands in public ownerships are administered by the national government, primarily through the United States Forest Service and the United States Bureau of Land Management. About four percent is administered by state agencies and two percent by counties, cities or other local governments.

In the eastern states, over four fifths of the timberland is privately owned. In the western states, however, more than two thirds is in public ownership and most of this is within the national forests administered by the United States Forest Service.

Two thirds of the 240 million acres (97 million hectares) of noncommercial forests are in public ownership. These, also, are mainly in western states.

Half the Timber Volume is Privately Owned

Fifty-five percent of the volume of growing stock and half the volume of sawtimber is in private ownership. In the eastern states, about 90 percent of the timber volume (both growing stock and sawtimber) is on private land; in western states, by contrast, only 40 percent of the timber volume is in private ownership. More than 90 percent of the growing stock on western public lands is on national forest or other areas managed by the national government.

Private holdings contain most (nine tenths) of the hardwood sawtimber but public holdings embrace most (55 percent) of the softwood sawtimber in the nation.

Most Accessible Timber in Eastern States

Most of the forests in the United States are accessible and the most accessible timber is largely on private holdings. Due to the character of the land, the economy of the eastern states is more developed than in the west and forests are generally more accessible. In parts of western states, accessibility is still a serious problem, mainly on public lands in mountainous areas. An expanding program of road building, however, promises to insure reasonably good access to the old growth timber on such areas within the near future. The virgin, remote timberlands of interior Alaska, estimated to contain 32 billion cubic feet (nearly a billion cubic meters) of growing stock, are today the only truly frontier forests in the United States.

Productivity of Forests

One quarter of timberland inadequately stocked

Nearly half of the commercial forest land is well-stocked (70 percent or more) with trees presently or potentially suitable for merchantable wood products. One tenth of the commercial area is nonstocked or is less than 10 percent stocked. However, nonstocked areas, together with areas only poorly stocked (10 to 40 percent), comprise about one quarter of the commercial acreage, and offer some of the best possibilities for increasing the timber supply. Much of this acreage of inadequate stocking is the result of heavy cutting and forest fires in past decades.

Some timberlands are restocking naturally and satisfactorily under protection from fires and other hazards. But planting or seeding is needed on approximately 50 million acres (20 million hectares) if these areas are to be restored to productivity within a reasonable time. Nearly 85 percent of this plantable area is in eastern states and about the same percent of the total is in private ownership.

Appraisal of recent cuttings

Since the condition of a forest after logging greatly influences growth, the results of an appraisal of the productivity of recently cut lands is of interest, particularly since in the United States between 10 and 20 million acres (4 and 8 million hectares) of forest are cut over each year. This appraisal of lands logged within a recent five-year period considered the following four significant factors to determine a productivity index:

1. present stocking;
2. prospects for stocking where stocking was deficient;
3. species composition;
4. stand age at the time of felling. Results of the appraisal showed that within the gross forest area of current cutting operations about two thirds of the acreage of recent cuttings was in the upper productivity class (index of 70 to 100), 24 percent in the medium class (index of 40 to 69), and 11 percent in the lower class (index of 0 to 39).

Industrial and public holdings in best growing condition

The recent cuttings on private lands managed by forest industries and those on public lands are in much better condition than those on farm and other private holdings. On forest industry and public lands about four fifths of the recently logged areas are in the upper productivity class; on other lands less than half are in that class. Regardless of ownership, large holdings are generally in better growing condition than small holdings. For example, on all large private ownerships over 50,000 acres (20,000 hectares) in size, nearly 80 percent qualify in the upper productivity class; on all small ownerships less than 5,000 acres (2,000 hectares) in size, only 40 percent qualify in the upper class.

Volume and Growth Trends

Growing stock increasing: softwood sawtimber volume decreasing

For a proper evaluation of timber supplies a look at the trends in volume and growth is needed. The volume of hardwood growing stock in the United States has been increasing by about 2 percent a year, and that of hardwood sawtimber by about 1 percent annually. The volume of softwood growing stock is apparently being maintained. However, the volume of softwood sawtimber (from which the largest amounts of forest products are produced) has been decreasing at a rate of about ½ percent annually.

Current annual net growth of timber i.e., volume growth on growing stock trees after deductions for losses through mortality due to fires, insects, diseases and other causes, was about 14 billion cubic feet (nearly 400 million cubic meters) in 1952, a favorable 4 percent higher than it was about ten years before. In the same year, net annual growth of sawtimber was about 47 billion board feet (210 million cubic meters of roundwood), 9 percent higher than it was 10 years previously.

Forty percent of sawtimber growth in southern pines and Douglas fir

Most of the timber growth is in eastern states where the large majority of timber stands are relatively young, generally less than 50 years of age. Most of the stands in western states are much older, many are several hundred years of age. About 30 percent of the total sawtimber growth, and 25 percent of the growth in growing stock, is that of southern pines. Douglas fir, the most widely used wood in the country, also contributes a large amount of the growth. The annual growth of this species is now nearly 10 percent of the national total in sawtimber and more than 5 percent of the total in growing stock. Annual growth of Douglas fir and

of other western species is expected to increase as more virgin forests in the west are converted to young, managed stands.

Quality of growth declining

Although details are lacking on quality of growth nationwide, some indications point to significant declines in supplies of high-value material. In the eastern states, for example, about 40 percent of the hardwood sawtimber volume and approximately 70 percent of the softwood volume is in trees no larger than 15 inches (about 38 centimeters) in diameter. Therefore, sawtimber growth in the eastern states is mainly on trees too small to yield high-quality lumber, veneer and other products for which there is a sustained demand. Also, a large proportion of the growth is on the less desirable species. Among the oaks, for example, which contribute three eighths of the hardwood growth, more than half of the growth is in species which are least valued by the market. Striking decreases are also occurring in the volume of such valuable trees as sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*).

Large Losses due to Insects, Diseases, Fires

Annual mortality at 100 million cubic meters

Three and a half billion cubic feet (100 million cubic meters) of growing stock were killed during 1952 in America's forests by such destroyers as insects, diseases and fires (Figure 5). Nearly 13 billion board feet (60 million cubic meters of roundwood) was sawtimber; only one quarter of this was salvaged for wood products. Two thirds of the growing stock losses and four fifths of the sawtimber losses were in softwoods.

Insects destroy most timber

In 1952, insects destroyed twice as much sawtimber as diseases, and they killed nearly seven times as much as fires (Figure 6). Losses from weather, animal damage and other causes were about one third of the total mortality of sawtimber.

One half of the average annual kill in growing stock and three quarters of the kill in sawtimber was in western states where overmature, and thus more susceptible, trees comprise large proportions of the stands.

Mortality by various causes continues to have a serious impact on the nation's growing stock, although the amount of mortality varies from year to year with fluctuations in weather, insect populations and incidence of disease.

Growth loss is double that of mortality

Less spectacular than outright kill of trees above 5 inches in diameter, but nevertheless extremely serious, is the growth loss due to diseases, fires, and insects. Examples of such growth losses are those caused by delay in restocking, by changes in timber types, by defoliation, by reduction in tree vigor, by increase in

Figure 5. – *Forest fires have ravaged some of America's best timberlands in the past. These snags today bear witness to the Tillamook Burn of the 1930's that covered a quarter of a million acres of virgin forest in the State of Oregon. Modern fire detection and suppression organizations now effectively protect about 70 percent of the timberlands in normal years, but conflagrations still occur when critical combinations of weather and forest fuel favor the spread of fire.*

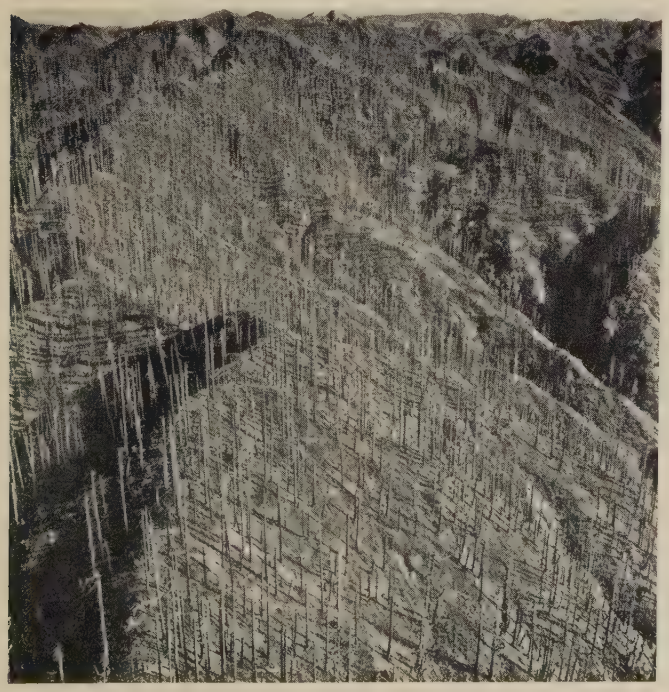
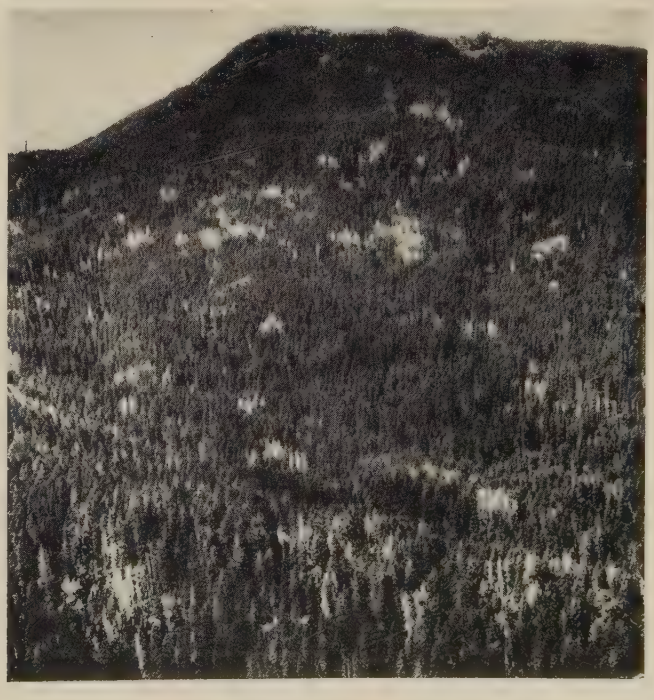


Figure 6. – *In the United States during one recent year insects destroyed nearly 5 thousand million board feet (11.8 million cubic meters) of sawtimber. This was about twice the kill by diseases and nearly seven times the toll by fires. Much of the loss from insects is caused by attacks on small groups of trees scattered throughout the forest. Group kills by bark beetles are indicated in this photograph by light-colored trees. State of Oregon.*



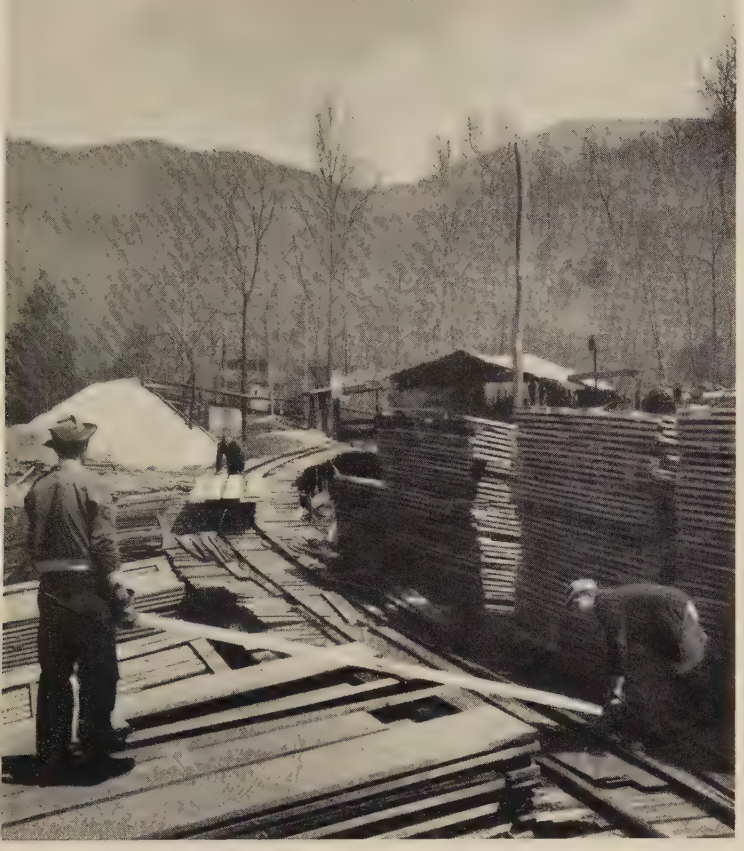


FIGURE 7. – *Small portable sawmills, such as this one cutting hardwood lumber in the State of North Carolina, are common in the eastern United States. These mills can be moved easily throughout the forest to saw a small volume of timber at each location. Many lack facilities, however, for sawing more than rough lumber from small trees; and the opportunities for full utilization of the timber are far less than those at large integrated plants such as the one shown in Figure 9. In some areas, particularly in the South, slabs, sawdust and other residues from small sawmills are collected and transported to pulp plants for conversion into pulp products.*

decay or by reduction in soil productivity after a damaging attack. It is estimated that such losses in annual growth are now double those due to mortality, and that diseases account for nearly half this growth loss.

In effect, the net growth of America's forests could probably be boosted by 50 percent (and that of sawtimber could be doubled) if all the damage now caused by destructive agents could be eliminated.

FOREST INDUSTRIES

In America, there are almost 6,000 uses for wood. About 50,000 plants are engaged in primary manufacture of forest products from roundwood in the United States.

Most of America's wood-using plants are sawmills

About 46,000 of these plants are sawmills which form parts of the lumber industry. They vary from small mills situated close to the forest, each employing only a few people (Figure 7), to huge plants with facilities for turning out finished, seasoned and graded lumber. The large plants are located mainly in cities or on main transport routes. Each may employ several hundred full-time workers and produce 100 million board feet or more of lumber annually. Sawmills are found in every state in the Union. Small sawmills are particularly numerous in the states along the eastern seaboard. Most of America's large mills are located in the Pacific Coast states of Washington, Oregon and California.

FIGURE 8. – *Wood yard and large pulp mill in the State of North Carolina. The United States has approximately 300 pulp mills. About 75 of these mills are located in southern states where pine is abundant. They comprise one half of the pulping capacity of the nation, turning out a variety of papers and paperboard.*

Pulp and paper industry growing

The pulp and paper industry has been growing faster than any other forest industry in the country. It is concentrated mainly in the southern and Pacific Coast states. A recent canvass indicated that 75 of approximately 300 pulp mills in the United States are situated in 12 southern and southeastern states [2]. These have a combined pulping capacity of more than 44,000 tons per day and represent over half the national pulping capacity. Most of these plants, in addition to turning out raw pulp, produce a variety of derived products including newsprint, other papers and paperboard (Figure 8).

Many other forest industries

Other important industries are those processing roundwood into veneer (plywood), cooperage, piling, utility poles, railroad ties, mine timbers and chemical wood. Many other plants, such as those producing furniture, are engaged in the secondary manufacture of forest products.

All together, it was estimated in 1952 that timber-connected activities (growing, protecting, harvesting, processing, transportation, distribution and fabrication of timber products) contributed nearly 15,000 million dollars to the national income or some 5 percent of the total.

Four Fifths of the Yearly Cut is Sawtimber

About 11,000 million cubic feet (311 million cubic meters) of growing stock is harvested annually. More than 80 percent of the cut is from sawtimber-size trees. About three quarters of that is for saw logs and veneer logs and bolts. The other one quarter is harvested for pulpwood and other products. Three quarters of the sawtimber cut is from softwoods. In the western states, virtually all the cut is softwood; in the southern states, about three fifths is softwood; but, in the northeastern states, more hardwoods than softwoods are cut.

Sawtimber cut increasing in western states

The western states have recently been furnishing an increasing proportion of the national sawtimber cut. Last year, they furnished over half the volume of saw-logs and about two thirds of the softwood lumber produced in the country. In contrast, the sawtimber cut of southern softwoods has been dropping. This trend is expected to be reversed as the high-volume old growth stands in the western states are cut over and the distribution of timber cut is more closely related to areas of forest and to growth capacities of the land. Since the demand by the market for softwoods is expected to increase, maintenance of the surplus growth of southern softwoods will be essential until these adjustments in the cut of western softwoods can be completed.

[2] States of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

One Fourth of Timber Cut not Used

About one quarter of the timber cut is not utilized. It is either lost as residues in logging or as unused plant residues. Losses from these sources are approximately equal. In 1952, about 1,400 million cubic feet (nearly 40 million cubic meters) of unused residues were estimated from each source. Utilization of timber cut varies significantly by kind of product produced. Only two thirds of the timber cut for lumber and 75 percent of the cut for veneer is used, but nearly all the cut for pulpwood is used.

Trend is to integrated industries for better utilization

In recent years utilization has been improving. More efficient logging and manufacturing equipment has been developed and widely adopted. Production of new wood products such as particle boards and greater use of by-product materials for pulp and paper have helped to reduce the amount of unused residues. The trend

Figure 9. – *This manufacturing complex on the Pacific Coast illustrates a strong trend in the United States toward integrated forest industries. Here logs, from the large pond on the left, are sorted and graded before processing. After debarking they go to the plant where highest quality wood is removed — such as veneer or clear lumber. Residues from that operation go into a pulp or fibreboard plant for essentially complete utilization.*

toward integrated industries — where a pulp mill, fibreboard plant or other facility for relatively complete wood utilization is located adjacent to a sawmill or veneer mill — is notable in increasing utilization in both woods and mill (Figure 9). Companies with integrated plants can better afford to bring in relatively low-value wood from the forest along with high-value material. By grading and sorting at the plants before manufacturing, all logs are sent first into a plant which demands the highest quality material, for veneer or lumber. The residues from that operation are sent along with other lower quality wood for essentially complete manufacture into byproducts such as pulp, wood chemicals, or fibreboard.

Higher Demand for Wood Expected

Potential demand for wood products in the United States is expected to rise along with anticipated growth of population and economic activity. The United States Forest Service recently developed three projections of potential future timber demand, low, medium and high, based on specific assumptions of prices for wood products and increases in population and gross national product. The medium demand projection — the basic projection — indicates that by the end of the century demand for timber in the United States may be nearly twice as great as it was during mid-century (about 83 percent higher in the year 2000 than in 1952).

Greatest demand is for lumber and pulp

The two main product components of this estimated demand are lumber and pulpwood. *Per caput* consumption of lumber has been declining. Total consumption, however, has held up well in the past and future increases are anticipated, as much as 25 to 50 percent over that in 1952 by 1975. *Per caput* consumption of pulpwood has tripled in the last three decades and total consumption has increased about five times. Projected total demand for pulpwood to supply United States markets for paper and paperboard in 1975 indicates increases of at least 100 percent over 1952 and 50 percent over 1959. A large increase in the demand for plywood is also expected.

Consumption of fuelwood is dropping

Fuelwood is the only wood product for which a significant drop in demand is anticipated. This is a continuation of the downward trend of fuelwood consumption for several decades past. On the other hand, the demand for miscellaneous wood products is expected to hold its own or possibly increase.

Aim to Double Timber Growth by End of Century

In view of potential demand for wood, it is highly desirable that timber growth in the United States be considerably increased within the next half century. The Forest Service has indicated a goal of raising the net annual growth of growing stock from 14,000 million cubic feet (nearly 400 million cubic meters) in 1952 to 22,000 million cubic feet (over 620 million cubic meters) in 2000. For sawtimber the goal is to increase the net from 47,000 million board feet (210 million cubic meters of roundwood) in 1952 to 105,000 million feet (nearly 470 million cubic meters of roundwood) in 2000.

Substantial Progress Made in Forest Management and Utilization

Whether desired increases in growth can be obtained depend largely on the rate of progress in forest management and utilization practices. There are several indications of good recent progress in this field, including the relatively good productivity of recently logged lands on large industrial and public holdings referred to earlier.

Improved fire protection

Fire protection on timberlands is continually being improved and is now adequate to guard nearly 70 percent of the timberlands in normal fire seasons. Organized fire protection is increasing at a rate which is expected to reduce the average area burned annually to less than 9 million acres (3.6 million hectares) within a decade. This would be 2 million acres (some 800

Figure 10. – *Many of the 2 thousand million trees planted last year in the United States were machine-planted. This tree planter is operating in the State of Mississippi where level terrain on southern pine land favors machine operation.*

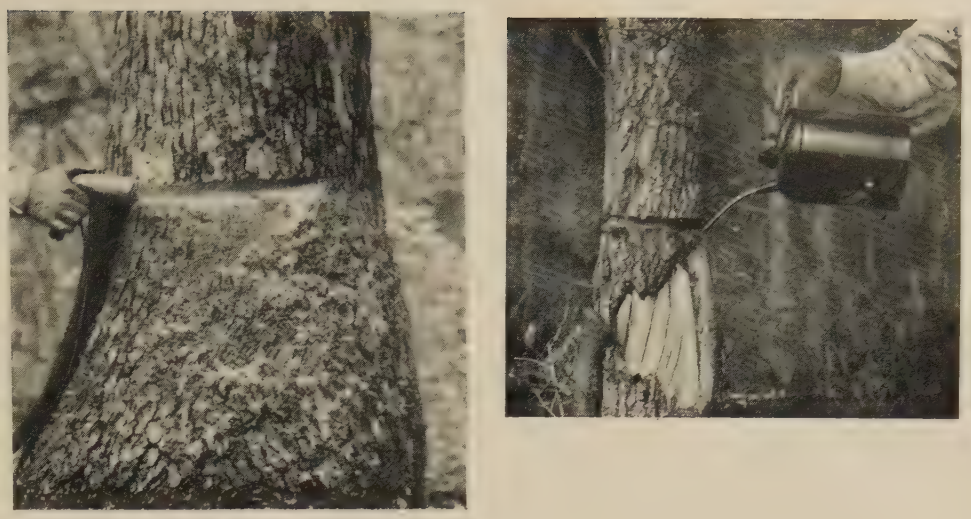


FIGURE 11. – *Increasing numbers of forest managers are improving their stands by removing or killing inferior trees to release and improve growth on the more desirable trees. Left. The machine called "Little Beaver" is commonly used for rapid girdling. Right. A defective forest tree in the State of Alabama is being chemically treated after girdling.*

thousand hectares) per year less than the area burned in the early 1950's and would be only one fifth of the average annual burn three decades ago.

Better control of insects and diseases

Detection and control of insects and diseases is now under way on an organized basis, encouraged by such actions as the passage of the National Forest Pest Control Act of 1947. Increased research in forest genetics also aims at developing strains of trees that will resist attacks by forest pests.

Big increases in plantations

Tree planting is also being stepped up remarkably (Figure 10). The rate of planting has increased more than five times within the past quarter century. About 1.5 million acres (over 600 thousand hectares) of land were planted to trees in 1958 and over 2 million acres (more than 800 thousand hectares) in 1959. Some of these plantations were on land diverted from farming as a conservation reserve under provisions of the National Agricultural Act of 1956 (Soil Bank). The latest nationwide appraisal, in 1952, showed more than 5 million acres (over 2 million hectares) of acceptable plantations in the country. About equal acreages were on private and public lands. Most of the acreage was in southern and northeastern states.

Seeding accelerated

Direct seeding of trees, where climate, soil and tree species are favorable, has been greatly encouraged by development of a chemical dip for coating the seeds with a repellent to prevent birds and rodents from eating them. Both aerial and hand methods were used for seeding 109,000 acres (44,000 hectares) in 1959, more than twenty times the acreage seeded annually only five years before.

Stand improvements

Stand improvements — by removing worthless or less desirable trees, by pruning desirable trees to improve their quality and by actions to encourage stand regeneration — are being used increasingly, particularly by forest managers of large industrial and public holdings (Figure 11). Timber stand improvement probably offers the greatest opportunity to secure added growth and quality.

SUMMARY OF OUTLOOK

Timber is reasonably abundant in the United States today. The annual growth of hardwood growing stock exceeds the annual cut by a wide margin while the growth and cut of softwood growing stock is nearly in balance. The growth of sawtimber nearly equals the annual cut; a surplus growth of hardwoods of approximately 7,000 million board feet (35 million cubic meters of roundwood) almost equals the deficit of approximately 9,000 million board feet (45 million cubic meters of roundwood) in softwoods. Although no timber famine is in prospect, shortages of some preferred species and quality timbers may be expected as old growth timber supplies of Douglas fir and other western species are reduced. These provide a large part of the cut of softwood sawtimber which comprises three quarters of the national sawtimber cut. The job ahead is to keep the growth of the kind of timber used in balance with the total annual harvest and, at the same time, build up the level of growing stock sufficiently so that it will be able to supply the needs of the future.

The increasing demand for woods products from the forests of the United States is expected to rise strikingly with growth of population, and the demand for wood by the year 2000 may well be double that of today. Unless the recent rate of progress in forest management, substantial though it is, can be greatly accelerated, the projected growth will be less than the projected demand. Within a few decades that increased

demand could not be met without cutting deeply into forest capital.

American foresters, therefore, are faced with a great challenge: to take action during the next few years to insure an abundant continuing supply of wood on all timberlands, particularly on the small private woodlands held in about four and one half million different ownerships which must supply nearly half of the nation's timber needs in the future. The United States must look forward to intensified actions such as the following:

1. a mounting acceleration of tree planting — in terms of thousands of millions of trees per year — to insure restocking of idle and cutover timberlands;
2. increased care in cutting of commercial products and supplementary stand improvement measures to improve the productivity of stands by encouraging growth and regeneration of the most desirable trees;
3. more intensive control of forest diseases, fire and insects;
4. more conversion into useful wood products of the timber cut now left as logging and mill residues.

These actions offer some of the most promising prospects for rapidly increasing the timber supply of the United States of America.

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(3) ———. "Improving Small Woodlands in the United States," Unasylva, Vol. 13, No. 2, 1959).

This excellent likeness of Marcel Leloup, Director of FAO's Forestry and Forest Products Division for 12 years and founder of Unasylva, *was executed by Carlos Flinta, a member of the Division. The bust is cast in bronze.*

End-Use Statistics

FAO Staff

For the major raw materials, many countries are making a serious effort to assemble and keep up-to-date statistics on consumption by end uses. This work is conducted by government departments, trade associations or development associations, or often their efforts are combined. There is now widespread recognition that this type of information is vital to the determination of national policies on raw material and to public and private industrial development plans.

End-use statistics for forest products, however, are relatively undeveloped although comprehensive inquiries have been undertaken in a few countries, for instance Finland and the United States. Nevertheless, scattered data are available in most countries, for example, through the materials usage sections of periodic basic national industrial inquiries. A number of countries have also made periodic studies of the flow of roundwood categories and species to various wood-using industries.

For forest products, transformation statistics [1] and end-use statistics [2] can be grouped together as they complement each other, making it possible to establish what is, in effect, a flow chart of forest products from the felling stage to final consumers. Statistics outlined in such a flow chart will facilitate an assessment of the impact on forest product supply, especially in the medium and long-term, of changes which are taking place at the consumption stage, whether these changes arise from changes in wood consumption per unit of output (e.g., sawnwood consumed per dwelling unit) or from changes in the relative importance of different sectors of wood consumption (e.g., the increasing importance of the "manufacture of paper products" sector in relation to other sectors). Secular changes which are taking place at the consumption stage are reflected in the roundwood categories, and thus can be translated into long-term changes in industry's requirements from the forests. Thus statistics on end-use and transformation are of importance both to those concerned with the evolution of forest products markets and to those responsible for the formulation and implementation of forest policies.

To date, work has been concentrated on the collection of transformation statistics which measure the volume of economic activity in the forest products industries. In the case of such products as sleepers (sawn and hewn) and newsprint, transformation statistics are perhaps sufficient as each of these products have a limited major end-use. But end-use statistics take on a particular importance today, since the increase in the price of wood relative to certain of the materials that compete with it, is leading to economies in the use of wood as well as to its displacement by other materials.

Forest products flow chart

The flow chart shows in graphic form the most important end-uses as they are derived from the main groups of roundwood. It distinguishes five stages of the movement of products from the forests to consumers, namely:

1. fellings and removals (fellings less logging and transportation losses) from the forests and from trees outside the forest (shown on the left side of the chart);
2. transformation of the removals into the roundwood categories, i.e., into sawlogs, veneer logs and logs for sleepers; pulpwood (wood for defibration or pulping); pitprops; poles; other industrial wood; and fuelwood;
3. apparent utilization of the specific classes of roundwood by the primary processing industries, or, in other words, transformation by the forest products industries (namely sawmills, veneer and plywood mills, pulp and paper mills, fibreboard mills and particle board mills);
4. production of intermediate (veneers, woodpulp, etc.) and/or final products (plywood, paper and paperboard, fibreboard, particle board, etc.);
5. consumption in the various end-uses (construction, packaging, coal mines, etc.).

It should be noted that apparent consumption (production plus imports minus exports) can be determined from statistics outlined in the flow chart because allowance is made between each stage for trade in the various wood categories. The chart also includes wood

[1] *Transformation statistics* are concerned with the volumes that are taken into the manufacturing processes for further conversion. These statistics may be for roundwood, semiprocessed wood products and/or wood residues. They constitute the inputs, the apparent consumption or the apparent utilization of the wood processing industries.

[2] *End-use statistics* relate to the last stage of utilization of forest products at which it is desirable and feasible to collect statistics.

ISIC (a) class	Consuming sectors	Products utilized (b)	Roundwood						Processed wood									Pulp and paper						Types of statistics (h)	Remarks
			Pitprops	Posts (c)	Piling (c)	Poles (c)	Other (round, split or hewn)	Fuelwood (d)	Sawnwood	Veneers (rotary sliced, other)	Plywood and Blockboards	Particle boards (incl. veneered)	Sleepers (e)	Charcoal (e)	Wood Agglomerates, N.E.S. (f)	Residues	Other (incl. match splints)	Newsprint	Printing and writing paper	Other paper and paperboard	Fibreboard	Woodpulp	Chemicals (g)		
01 to 04	A. Agriculture, forestry, hunting and fishing			X		X	X	X	X		X	X	X			X				X	X			(6)	If possible incl. all construction, show separately by ISIC class.
11 to 19	B. Mining		X						X				X			X								(1) (3) (5)	
23	C. Manufacture of textiles								X											X				(2) (6)	Spool cores, packaging
25 (part)	D. Manufacture of wood products																								
	I. Containers						X		X	X	X	X				X					X			(2) (6)	Pallets, boxes, crates, cooperage, etc.
	II. Joinery (i)								X		X	X								X	X			(2) (4)	Window and door frames, etc.
	III. Other						X		X		X									X	X			(2) (4) (6)	Incl. wood wool, turnery, etc.
26	E. Manufacture of furniture and fixtures								X	X	X	X								X	X			(3) (6)	
272	F. Manufacture of paper products																								
	I. Manufacture of packaging containers and materials																			X	X	X		(2) (6)	Mostly of pulp, paper or fibre
	II. Other pulp and paper products																			X	X	X		(6)	Incl. pressed pulp products
28	G. Printing, publishing and allied industries																	X	X	X				(1)	
31	H. Manufacture of chemicals and chemical products																								
	I. Matches						X			X							X			X				(2) (4)	Incl. paper matches
	II. Other						X							X		X						X	X	(1) (2)	Products of distillation, tannins, alcohols, cellophane, rayon, acetate, etc.
38	I. Manufacture of transport equipment				X	X			X	X	X	X								X	X			(3) (5)	Incl. boats
	II. Railway rolling stock and other transport equipment								X	X	X	X								X	X			(3) (5)	Incl. trailers (caravans), show use for railway rolling stock separately if possible
20-22, 24, 29, 30	J. Other manufacturing																								
	I. Wooden toys								X		X									X	X			(2) (4) (6)	Show packaging materials used as separate group if possible
32-37, 39	II. Other																							(6)	
40	K. Construction																								Exclude construction shown in "A" and joinery in "D II".
	I. Residential				X	X			X		X	X			X					X	X			(5)	Single, two-family, multi-family, wood, non-wood, etc.
	II. Nonresidential																								
	(a) Building				X	X			X		X	X			X					X	X			(5)	Incl. railway stations, etc.
	(b) Transportation and communication			X	X	X			X		X	X	X							X	X			(2) (5)	Incl. bridges
	(c) Other civil engineering			X	X	X			X		X									X	X			(2) (5)	Incl. dams, power plants, etc.
511 and 513	L. Power production							X								X								(4) (6)	Show use in electric power production separately if possible
	M. Other industries (public services, service trades, etc.)							X	X		X	X		X		X			X	X	X			(6)	Inc. wood burning. Show total if breakdown is not possible
	N. Households							X	X		X	X		X		X			X	X	X			(6)	

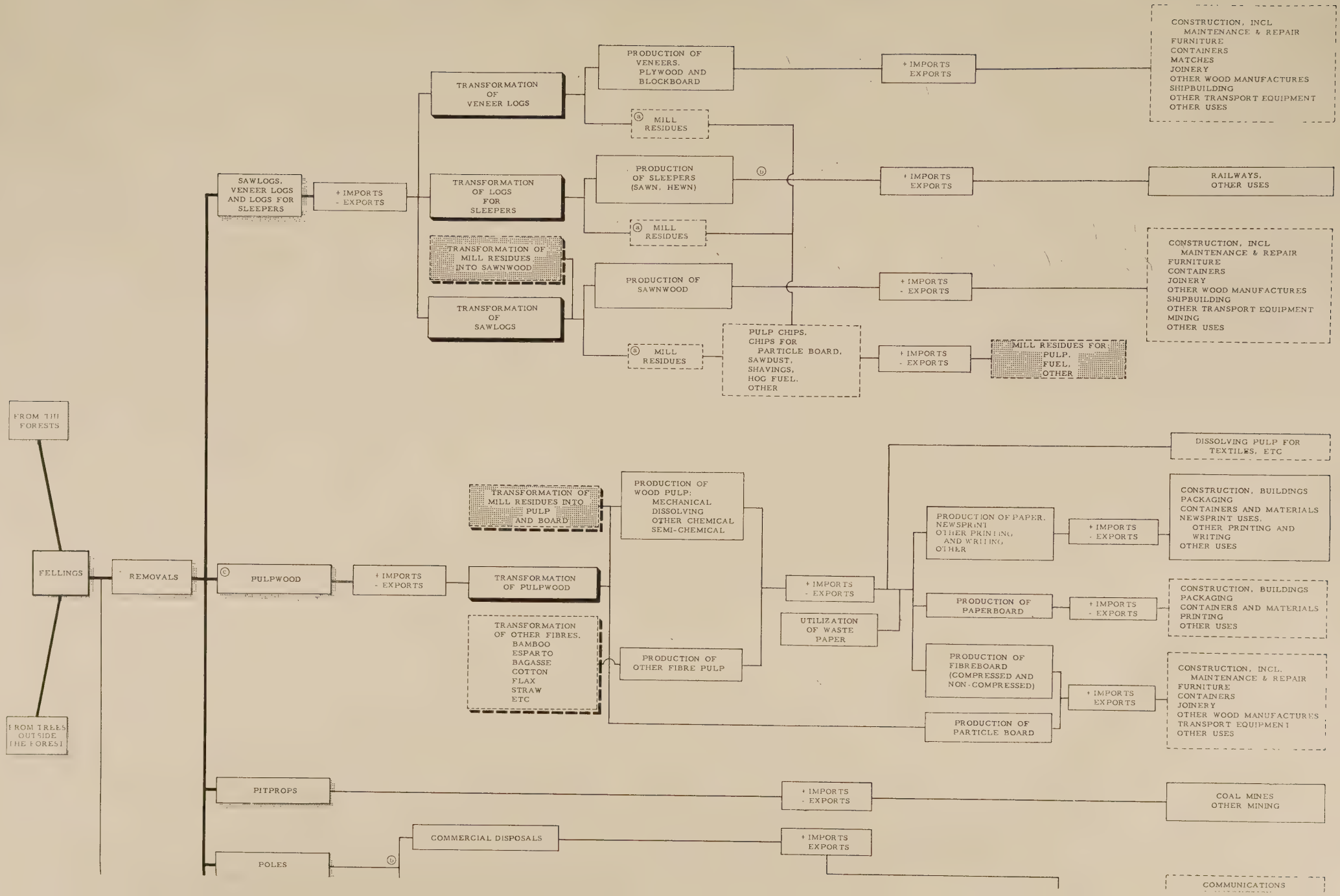
(a) International Standard Industrial Classification.
(b) Excluding transformation within the forest products industry, e.g. pulpwood and residues for pulp, sawlogs for sawnwood, etc.

SITC - BTN Classification: *

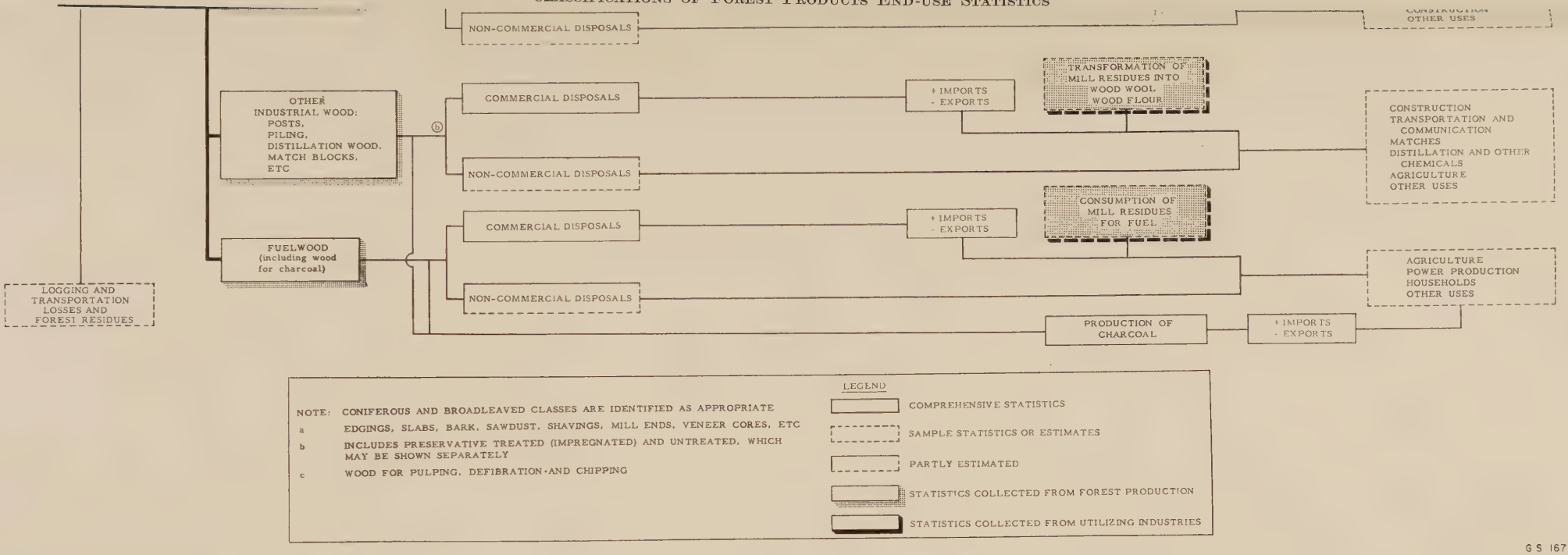
242.4 Pitprops	243.2, 243.3 Sawnwood	641.1 Newsprint
242.9 Posts, Piling, Poles, Other (round, split or hewn)	631.1 Veneers (rotary, sliced, other)	641.2 Printing and writing paper
		641.3, 641.5, 641.6 (part), 641.7, 641.9 Other paper and paperboard
	631.2 Plywood and blockboards	641.6 (part) Fibreboard
	631.4 (part) Particle boards (incl. veneered)	251.2, 251.6, 251.7, 251.8, 251.9 Woodpulp
241.1 (part) Fuelwood		Chemicals
	243.1 Sleepers	
	241.2 Charcoal, Wood agglomerates, n.e.s.	
	241.1 (part) Residues	
	631.8 (part) Other (incl. match splints)	

(c) Including both preservative treated (impregnated) and untreated. — (d) In many countries fuelwood is also used for heating in manufacturing industries. — (e) From pit kilns and portable ovens only, other charcoal is a product of the chemical industry. — (f) Including sawdust - cement blocks, etc. — (g) By-products of the woodpulp industry. — (h) The types of statistics are: (1) apparent consumption, (2) deliveries, (3) receipts, (4) actual inputs, (5) derived from output of the firm or industry, (6) other, including special surveys. — (i) Joinery built as part of building carpentry will appear in "K Construction" — a sector which in some countries may include all joinery.
* Combined SITC-BTN classification, reference Third Draft, November 1959; for definitions see *FAO Yearbook of Forest Products Statistics.*

FOREST PRODUCTS FLOW CHART


FROM THE FORESTS
FROM TREES OUTSIDE THE FOREST
FELLINGS
REMOVALS
SAWLOGS, VENEER LOGS AND LOGS FOR SLEEPERS
+ IMPORTS - EXPORTS
PULPWOOD
+ IMPORTS - EXPORTS
PITPROPS
POLES
TRANSFORMATION OF VENEER LOGS
TRANSFORMATION OF LOGS FOR SLEEPERS
TRANSFORMATION OF MILL RESIDUES INTO SAWNWOOD
TRANSFORMATION OF SAWLOGS
TRANSFORMATION OF PULPWOOD
TRANSFORMATION OF MILL RESIDUES INTO PULP AND BOARD
TRANSFORMATION OF OTHER FIBRES, BAMBOO ESPARTO BAGASSE COTTON FLAX STRAW ETC
PRODUCTION OF VENEERS, PLYWOOD AND BLOCKBOARD
MILL RESIDUES
PRODUCTION OF SLEEPERS (SAWN, HEWN)
MILL RESIDUES
PRODUCTION OF SAWNWOOD
MILL RESIDUES
PRODUCTION OF WOOD PULP: MECHANICAL DISSOLVING OTHER CHEMICAL SEMI-CHEMICAL
PRODUCTION OF OTHER FIBRE PULP
PULP CHIPS, CHIPS FOR PARTICLE BOARD, SAWDUST, SHAVINGS, HOG FUEL, OTHER
COMMERCIAL DISPOSALS
+ IMPORTS - EXPORTS
+ IMPORTS EXPORTS
+ IMPORTS - EXPORTS
+ IMPORTS EXPORTS
+ IMPORTS - EXPORTS
+ IMPORTS - EXPORTS
+ IMPORTS - EXPORTS
+ IMPORTS EXPORTS
+ IMPORTS - EXPORTS
+ IMPORTS EXPORTS
MILL RESIDUES FOR PULP, FUEL, OTHER
UTILIZATION OF WASTE PAPER
PRODUCTION OF PAPER, NEWSPRINT OTHER PRINTING AND WRITING OTHER
PRODUCTION OF PAPERBOARD
PRODUCTION OF FIBREBOARD (COMPRESSED AND NON-COMPRESSED)
PRODUCTION OF PARTICLE BOARD
DISSOLVING PULP FOR TEXTILES, ETC
CONSTRUCTION, BUILDINGS PACKAGING CONTAINERS AND MATERIALS NEWSPRINT USES, OTHER PRINTING AND WRITING OTHER USES
CONSTRUCTION, BUILDINGS PACKAGING CONTAINERS AND MATERIALS PRINTING OTHER USES
CONSTRUCTION, INCL. MAINTENANCE & REPAIR FURNITURE CONTAINERS JOINERY OTHER WOOD MANUFACTURES TRANSPORT EQUIPMENT OTHER USES
CONSTRUCTION, INCL MAINTENANCE & REPAIR FURNITURE CONTAINERS MATCHES JOINERY OTHER WOOD MANUFACTURES SHIPBUILDING OTHER TRANSPORT EQUIPMENT OTHER USES
RAILWAYS, OTHER USES
CONSTRUCTION, INCL MAINTENANCE & REPAIR FURNITURE CONTAINERS JOINERY OTHER WOOD MANUFACTURES SHIPBUILDING OTHER TRANSPORT EQUIPMENT MINING OTHER USES
COAL MINES OTHER MINING
COMMUNICATIONS

Classifications of Forest Products End-use Statistics


NON-COMMERCIAL DISPOSALS
OTHER INDUSTRIAL WOOD: POSTS, PILING, DISTILLATION WOOD, MATCH BLOCKS, ETC
COMMERCIAL DISPOSALS
+ IMPORTS - EXPORTS
TRANSFORMATION OF MILL RESIDUES INTO WOOD WOOL WOOD FLOUR
NON-COMMERCIAL DISPOSALS
CONSTRUCTION TRANSPORTATION AND COMMUNICATION MATCHES DISTILLATION AND OTHER CHEMICALS AGRICULTURE OTHER USES
FUELWOOD (including wood for charcoal)
COMMERCIAL DISPOSALS
+ IMPORTS - EXPORTS
CONSUMPTION OF MILL RESIDUES FOR FUEL
NON-COMMERCIAL DISPOSALS
AGRICULTURE POWER PRODUCTION HOUSEHOLDS OTHER USES
LOGGING AND TRANSPORTATION LOSSES AND FOREST RESIDUES
PRODUCTION OF CHARCOAL
+ IMPORTS - EXPORTS
b
NOTE: CONIFEROUS AND BROADLEAVED CLASSES ARE IDENTIFIED AS APPROPRIATE
a EDGINGS, SLABS, BARK, SAWDUST, SHAVINGS, MILL ENDS, VENEER CORES, ETC
b INCLUDES PRESERVATIVE TREATED (IMPREGNATED) AND UNTREATED, WHICH MAY BE SHOWN SEPARATELY
c WOOD FOR PULPING, DEFIBRATION AND CHIPPING
LEGEND
COMPREHENSIVE STATISTICS
SAMPLE STATISTICS OR ESTIMATES
PARTLY ESTIMATED
STATISTICS COLLECTED FROM FOREST PRODUCTION
STATISTICS COLLECTED FROM UTILIZING INDUSTRIES

GS 1671

residues which have been increasing in importance during the past decade, and distinguishes coniferous and nonconiferous wood in all categories. It is evident from the definitions that the end-use statistics do not necessarily refer to the true final stage of consumption (e.g., the volume of plywood used by packaging firms is an end-use statistic although the plywood is in many instances further fabricated into pallets, boxes, crates, etc.). In addition, the flow chart outlines (by means of the legend) the types of statistics to be collected at each stage by groups of products or consuming sectors, for example, comprehensive statistics, sample statistics or estimates, partly estimated, and whether statistics are to be collected from producing or utilizing industries. In order to complete the statistical picture, the flow chart recognizes nonwood fibres such as waste paper, bagasse, cotton, etc., which may be used by pulp and paper mills.

Classification table

To complement the information outlined in the flow chart, a special group of statistical experts called together by FAO and the United Nations' Economic Commission for Europe (ECE), has also approved a classification table of forest products end-use statistics. The classification table arranges in convenient form the main groups of consuming sectors (end-uses) and the main forest products utilized for each. The classification for the using industries follows the United Nations International Standard Industrial Classification of all Economic Activities (ISIC).[3] The major wood products (roundwood, processed wood, and pulp and paper) are listed and their utilization by consuming sectors is shown. The table also indicates the types of statistics that may be utilized in collecting the data (apparent consumption, deliveries, receipts, actual inputs, derived from output of the industry, and others including special surveys). As in the flow chart, it is evident that the end-use statistics outlined in the classification table are not necessarily at the final stage of consumption. This is borne out by examining, for example, printing and writing paper which is listed only as it is used by the consuming sectors: G. printing, publishing and allied industries; M. other industries; and N. households. These consuming sectors are in broad classes within which the actual end-use of the paper may be in the form of books, periodicals, stationery, etc.

Collecting statistics

As regards the techniques and problems involved in collecting forest products end-use statistics both in agriculture and in industry, there is great variation between countries both as to the needs and possibilities for collecting these data. It is considered that priority attention should be given to the collection of end-use statistics for the following:

1. *Products utilized:*

   Sawnwood, fuelwood, plywood and veneers, blockboard and particle board

2. *Consuming sectors:*

   Agriculture, containers and joinery sections of the manufacture of wood products sector, furniture, transport equipment, other manufacturing, construction and household.

The products utilized and consuming sectors referred to here are those where end-use statistics are particularly inadequately developed at present but which in terms of volume of forest products or industrial development are of primary importance.

The problem of end-use statistics can be tackled in two main ways:

(*a*) by concentrating on the several forest products consumed in a particular end-use; or

(*b*) by concentrating on the specific end-uses (consuming sectors) to which a particular forest product is put.

However, the approach adopted in any particular instance will depend largely on the kind of data already available and the techniques which can be devised for collecting supplementary data. For practical purposes it is probably preferable to use approach (*b*) or a variation of this method, concentrating on a particular end-use to which a particular forest product is put. This approach is preferred because transformation and trade statistics for forest products are generally well developed and it is possible to determine apparent consumption for most products. Where statistics on stocks are available for the various forest products, consumption can be determined with greater accuracy. With information on consumption for a particular forest product, it is possible to begin investigations on its major end-use after which the picture may be completed in sequence, by investigating the other end-uses.

FAO is recommending that future programs for the collection of transformation and end-use statistics in its member countries should be guided by the nomenclature and classification shown in the classification table and flow chart accompanying this article. Adoption of this recommendation would lead to uniformity between countries based on accepted international classifications, and to comparability of statistics with the possibility for aggregation by regions and subregions.

In the field of techniques of collection, the expert group already referred to received information from Finland and the Union of Soviet Socialist Republics on the collection of wood use statistics in the sector of agriculture. Both of these countries have had consid-

[3] *International Standard Industrial Classification of all Economic Activities.* Statistical Office of the United Nations. Statistical Papers Series M. No. 4, 31 October 1949, New York.

erable experience in this difficult sector. In the manufacturing sector, information was received from 15 countries. [4]

Analysis of statistics

For most analytical purposes, it is probably sufficient to collect end-use statistics by the consuming sectors shown in the classification table and flow chart, although these statistics are not necessarily at the final stage of consumption. However for certain studies, for instance, the FAO/ECE study, *Trends in the Utilization of Wood and its Products in Housing* [5] and the Stanford Research Institute study, *America's Demand for Wood 1929-1975*,[6] a further breakdown to the final stage of consumption may be desirable and feasible. Generally such information is not regularly compiled but is obtainable from special supplementary inquiries. For instance, in the two studies mentioned above, data are given on the amount of wood used in new residential construction but in addition volume data are provided on the amount of wood finally consumed in:

1. walls, which determine whether the structure is a wood or nonwood unit;
2. structural elements, including information on roofs, flooring and ceiling joists, etc.;
3. joinery elements, including information on windows and window frames, doors and door frames, flooring, etc.;
4. auxiliary timber, including scaffolding and form work.

The aim of the Stanford study was to estimate for a base year the consumption in the major consuming sectors of each of the major forest products in the United States and to project these estimates for future target years, at the same time estimating future roundwood requirements and explaining historical variations in production and consumption of these forest products. The FAO/ECE study had the more limited aim of assembling and reviewing such evidence as was available on trends in the utilization of only one forest product, sawnwood, in a particular consuming section, new residential construction, although reference was made to other forest products used for housing. In addition, both studies deal with competing nonwood materials.

To conduct a thorough study on the consumption of wood in any or all consuming sectors, as in the two studies above, it is necessary to consider all the various social, technological and economic factors which affect consumption of the product. For instance, the total volume of wood consumed in new residential construction depends on the number of dwelling units built and the amount of wood used per dwelling unit. But, in this regard, social factors, such as changes in population structure and its distribution, affect the number of dwelling units constructed. Moreover, over a period of time, the typical new dwelling unit may change in size (floor space and ceiling height) while the number of stories, style (architecture) and type (single-, two- and multi-family) of structures containing dwelling units may also undergo changes. An economic factor is the price of wood because wood must remain competitive in price with other building materials in order to avoid replacement or substitution. Technological factors, too, may affect substitution or, to be more exact, the decrease in the amount of wood used per unit of consumption. Timber savings may accrue owing to the more rational use of wood (i.e., a form of substitution), when sawnwood is replaced by other wood products and finally where wood is replaced by a nonwood material.

In order properly to assess in time the changes that take place, it is desirable to study changes in the four main components in which wood enters housing construction, i.e., walls, structural elements, joinery elements and auxiliary timber. The FAO/ECE and the Stanford studies estimated time changes in sawnwood consumption in residential construction and indicated changes due to social, technological and economic factors; and also estimated changes in the final end-uses in housing.

A revised list of categories

In a field that is quite similar to end-use statistics, a reminder list has been compiled on the classification of wood-use statistics by industry group and product category, designed to be of use to countries in their preparations for the 1963 world program of basic national industrial inquiries.

This world program stems from a resolution of the Economic and Social Council of the United Nations (ECOSOC) which recommends that the governments of Member States compile basic data on industry (mining, manufacturing, construction, and the production of gas, electricity and steam) for 1963 or a year close to 1963, taking into account as far as possible the recommendations which have been made to improve the international comparability of the collected data.

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[4] Austria, Belgium, Bulgaria, Canada, Czechoslovakia, Finland, France, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

[5] *Trends in the Utilization of Wood and Its Products in Housing.* A study prepared jointly by the Secretariats of the Food and Agriculture Organization and the United Nations Economic Commission for Europe, 49 pp. Geneva, 1957.

[6] *America's Demand for Wood, 1929-1975.* A report by the Stanford Research Institute to the Weyerhaeuser Timber Company, 404 pp. Sunnyvale, California, June 1954.

Planning for Watershed Development

John Blackmore
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Planning is a process for deciding what to do and how to do it. It is particularly important in connection with watershed improvement. The problems of a watershed area are usually so tangled and so complex it is hard to know where to begin. Moreover, it is often the case that the solution of problems that seem obvious on first study may turn out to depend upon the solution of more fundamental problems when more careful investigations are made. It is not uncommon, for example, for a catchment area to present a need for terracing as a means of controlling surface flows of water, but for the terracing to be impossible until some means is found for rationalizing a highly fragmented pattern of land ownership. Similarly there are areas where the need for afforestation is obvious but where it is not possible for afforestation to succeed until some changes are made in customary grazing rights on the land.

It is also usually the case that one aspect of the development of a catchment area will depend on what is to be done elsewhere. The silt storage capacity to be designed into reservoirs will depend in part on the action to be taken to control erosion on the lands of the catchment area. Plans for the control of grazing are usually dependent upon the development of some alternative source of forage for the grazing animals. All of these aspects of watershed improvement are related and careful planning is necessary if the work is to lead to a successful result.

While watershed improvement work can produce spectacular results, it requires both money and time and, if these are not to be wasted, careful attention must be given to the planning of each project. It is tragic when 10 or 15 years' time is wasted because efforts have been made to produce a forest cover on lands not suited to the purpose; it is equally wasteful of resources when engineering structures are built, only to silt up quickly because not enough attention was given to erosion control work above them. It is doubly wasteful when time and money is put into land improvement works which are allowed to fall into decay because no plans were made for their maintainance. The costs of careful planning of watershed improvement programs is small in comparison with the great investments that must often be made from both public and private sources. Particularly in countries where investment capital is in very short supply it should not be wasted as a result of a lack of careful planning of projects.

Plans for watershed management have two purposes. They are first of all a means for obtaining approval for funds to be spent and work to be done. There is never enough money nor enough time for all of the work of improvement and choices must be made as between projects. These choices are best made through a comparison of the plans for the alternate projects. It is difficult to decide whether investments should be made in the improvement of one catchment or another without knowing what each project is likely to cost and what the results are going to be. This knowledge comes out of project plans and the better the planning which is done, the more reliable will be the information on costs and results. Moreover, the better the project planning, the more confident will administrators be that the expenditures proposed will actually give the forecasted results. In most governments the process of approval for a project of work such as watershed improvement tends to be long and to involve the decisions of numerous people. A carefully prepared report on the project plan is a convenient device for simplifying and speeding the process of administrative approval.

A second purpose for a watershed project plan is to guide the work to be done. This is particularly important because most watersheds require a variety of kinds of action to be taken by many people, both private persons and officials of the government. Moreover it is often the case that responsibility for the work to be done by the government is divided among several bureaus or organizations. For example, there may be work for the Extension Service in advising farmers on cropping systems for arable land that will minimize soil erosion, the Forest Service may have afforestation work and fire protection facilities to build, an engineering service may be involved in the construction of dams. An agreed-on plan for the whole program of watershed improvement makes possible the necessary co-ordination among bureaus. It also serves as a means for making clear what can be done by the Government and what must be done by the private land users. A carefully prepared plan will also indicate the timetable for development, showing for example that certain land treatment measures for controlling erosion are to be installed before particular flood retarding reservoirs are built, thus precluding the possibility that the reservoirs may be quickly filled with soil materials washed from the uplands

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by destructive surface flows. The plan can also indicate the timing for developments that affect farmers' incomes so that to the extent possible the measures taken first will produce increases in income, thus making it easier for individuals to finance later parts of the necessary work.

Organization for Watershed Planning

A bureau or department responsible for watershed improvement needs a subordinate organization for watershed planning. The nature of such an organization will, of course, depend upon many things. It will depend, for example, upon the scope of the watershed work to be undertaken. Also it will depend upon the nature of the program responsibilities of the government bureau. A watershed improvement program of a Forest Service with responsibility in public forest areas will be different from that of an organization to deal with the mixture of problems found in catchment areas where all kinds of land uses and private as well as public lands are found. Similarly, the planning needs and the organizations for project planning will be different.

There are, however, some general principles which are useful guides for the organization of watershed improvement planning groups, regardless of either the size of the project, or the nature of the technical problems involved. In the first place the planning organization needs to be an integral part of the organization responsible for taking the action. The planning group, if it is organizationally separate from any body responsible for actually making the planned improvements will find its plans being ignored rather than being acted upon, and the action organization on the other hand will probably find it difficult to make use of the plans made by the independent planning group because of the apparent lack of attention to the practical problems of getting the work done. Planning and action must go hand in hand. There should be, of course, some degree of specialization. Not every member of the staff should be involved both in project planning and in project operations. The most satisfactory solution is usually found in having a relatively small planning team located in the operating organization where there is an easy communication between the planners and the project operations staff.

A second principle for guiding the structuring of a watershed planning organization is that the planning staff should include experts whose fields of interests cover all the aspects of watershed improvement that are involved in the areas under study. For example, a planning team for watershed improvement in the public forest may need to include only a hydrologist, forester and forest engineer. On the other hand a planning body required to deal with problems of arable and grazing lands as well as the forest, and with private land ownership as well as public lands, will need the skills of other kinds of experts. Such a planning body should have technical competence in grassland management and in agronomy and in addition should have experts with training and experience in the economics of farm organization and in land tenure, and in other institutional arrangements under which rural people live and produce their incomes.

It will most usually be found that the most satisfactory planning organization personnel are those who have had some practical field experience in action-type programs and have supplemented this with special training in their technical fields. Both practical experience and advanced training are important.

For some special types of watershed improvement work the necessary project planning should be done by the staff set up to operate the project. This is particularly true for research work and for pilot schemes. In these cases the size of the total program is usually so small as to not justify a separate project planning organization. Moreover, in research watersheds and in pilot area projects, the special considerations of data collection and analysis and the intimate relations between the plans for the work and the results to be evaluated are such as to suggest that the necessary project planning should be entrusted to the project staff directly rather than to a separate planning organization.

Types of Watershed Plans

It should not be necessary to go into any detailed discussion of engineering design as related to watershed improvement. The detailed design of structures for retaining water, for controlling erosion and for related purposes is adequately covered in many standard engineering texts. It is important, however, to note that equally detailed attention is justified to non-engineering aspects of watershed improvement projects. The careful detailed planning (design) of a program of afforestation for a particular watershed, or of an educational campaign to get land users to adopt erosion-retarding methods of crop cultivation is essential. Money and time are usually the most scarce resources in watershed improvement and these can be economized through carefully made designs, or work plans for each aspect of the improvement program. In engineering work a great deal of the time of highly skilled persons is devoted to careful planning of what is to be done. The same policy should be adopted for other features of watershed improvement work.

It is not easy to draw a line between planning and design, but some differentiation is useful. In the main, planning relates to the making of a decision as to what should be done, and designing is related to deciding how to do it. In engineering terms, design is usually understood to relate to the detailed planning of structures as a guide for those who will construct them. The same could be extended to other aspects of a watershed improvement program, with the term "design" used to mean the planning of detailed features of the operating program. However, it is more common to use the term "work plan" in connection with aspects of water-

shed work other than structural designs. This term will be used in this way in the report.

There are many kinds of watershed plans, each having a special purpose. In general, the purpose which the plan is to serve determines the nature of the plan. For some purposes reconnaissance planning is quite sufficient, and for other purposes extremely detailed planning is required. Also, for some purpose the planning may relate to a single technical aspect of the development of a watershed while for other purposes it is necessary to have a comprehensive and integrated plan covering all the many aspects of a catchment's development.

River basin planning

Watershed improvement and management is one of the important aspects of comprehensive river basin planning. Together with plans for the construction of main-river facilities for generation of electric power, storage of irrigation and flood waters, or to improve navigation, attention is needed on the plans for work needed on the watershed itself. In many parts of the world, to ignore the watershed is to invite disaster. Particularly in those areas where the soils are highly erosive, failure to plan for the control of erosion may result in the siltation of costly reservoirs long before the end of their planned economic life. It is unfortunately true that watershed planning is most often neglected in comprehensive river basin planning, or at most receives all too little attention. This is sometimes the case because the river channel structures are looked on as having a direct effect upon some major economic problem. They either provide an economic good such as electric power, or transportation, or irrigation water, or they minimize an economic loss such as flood damages. Watershed improvement, on the other hand, is often seen as being related only to the protection of the reservoirs themselves. In some cases it is possible to design into the reservoirs sufficient capacity for the storage of soil materials as to assure their useful life for a long period.

It is most often overlooked that the very work which is usually most necessary on the watershed for the protection of reservoirs is also of a nature which has a direct economic contribution to make. Practical soil conservation work is most often a form of improved land management which results in improving the productivity and usually the income from the land. In forests, in grazed areas and on arable lands this is found to be the case. The great possibilities for controlling erosion, and thus providing protection for reservoirs, is through getting private land users to adopt land management techniques which increase their incomes and, while doing so, preserve the soil resources in place, thus both sustaining the production of income and preserving the life of reservoirs. There are, of course, great areas in the world where the control of soil erosion is beyond the means of individual private land users, in these areas, to the extent they are in river basins where storage reservoirs are being planned and require that the designers of the dams and reservoirs include in their plans and cost estimates the necessary land treatment measures that must be undertaken at public expense.

As a minimum, the report of a comprehensive plan for a river basin area should have a special section on watershed improvement and management. Such a section should include a classification of the tributary catchments according to the nature and seriousness of the watershed conditions. It would be well for such a classification to be made from two points of view, from that of providing protection for structures to be built in the river channel, and from the point of view of increasing the economic welfare of the people on the land of the area. In the first instance the classification would highlight those areas where soil erosion control is most necessary in order to maintain the useful life of specific structures. A classification from the second point of view would highlight the areas where improved land management would make the greatest income contribution. A combining of both classifications would suggest the areas where the necessary reservoir protection could be expected to come from improved land management by private land users. It should also delineate the critical areas where public subsidy for land use improvements is needed in order to provide the needed reservoir protection.

The watershed improvement section of a river basin plan should also outline the various programs needed to get the necessary degree of land use improvement. It should cover afforestation, the management of grazing, and the use of arable lands. It should discuss necessary reforms in land tenure, desirable changes in legislation or government policy, adjustments needed in the organization of the Government's work, and should suggest lines for strengthening educational work among land users and other facilities of the Government such as agricultural credit and subsidy programs for aiding in improving the use of watershed lands.

Watershed area work plans

For purposes of this paper a watershed area work plan can be defined as one covering a catchment area which is to be the scene of a program of work. There is no useful measure of the size of such a watershed area. It can only be usefully defined as the area covered by a project work plan. In some cases where a very large project is envisaged the area may be several thousand hectares, in other cases it may be a watershed of very few hectares, perhaps only a half dozen farms. In any event, the significant feature of the area is that it is the subject of comprehensive planning, with the aim of indicating all of the various things to be done to achieve an improvement in the behavior of the stream that drains the area.

Because they are to serve as a basis for the developmental work, watershed area plans must be detailed and precise. They should indicate, by means of maps, tables, charts and text, exactly what is to be done, where it is to be done, by whom, how and when. This is discussed in some detail later in this article.

An important part of the planning report is the section on estimated costs. One purpose of the planning operation is to develop reliable estimates of the costs of the proposed work. In the course of the planning work various schemes may be planned and costed before one is selected as being most desirable from the point of view of technical feasibility and also relative costs. The reported cost estimates are useful in guiding decisions as to whether the planned work should be approved, and also in planning the financing of the scheme as between the Government and the land users most directly benefited.

Community development plans

Watershed improvement work is usually difficult because people live in the watershed area. It is not very difficult to plan and take action on the problems of a forested watershed where the land is all owned and controlled by the state and private persons neither live there nor have any rights to the use of the land. On the other hand, when private persons have rights to the use of watershed lands, their private interests as well as the public interest must always be taken into account. A most effective way of dealing with such problems is through community development schemes. Here the primary social groupings of people, the village or neighborhood, is used as the basis for some system of social or political organization. The objective of such work is to promote self-help on problems of land and water use and on other problems related to these. It is not often that the boundaries of a watershed coincide with that of a rural community grouping of people and thus the area for watershed planning and the area for community development planning are most often different. It is usually the case, however, that watershed areas selected for improvement projects cover the area of several rural communities, villages, or neighborhoods and thus there is often a possibility of encouraging the development of community improvement plans as a means for promoting land use and related improvements in a part of a catchment project area.

The planning of community development is primarily a means for organizing the action of private persons to make their contributions to the improvement of their community and the larger watershed area. The plan itself most often emphasises action on local problems, both community problems and individual farm problems. For example, a community improvement plan may include provisions for work on road improvement and on crop yield improvement. The road work may be planned as a co-operative undertaking in which every family provides labor or equipment. The crop improvement work may be strictly a matter for individual action.

Such community improvement work carried on as part of a watershed development project would of course place relatively heavy stress upon land use changes with desirable hydrologic consequences. These would include afforestation of privately-owned woodlands, control of grazing and fire in private or village forests, terracing and related water disposal systems, gully stabilization and other types of erosion control, improvement of vegetative cover on pastures, and other changes in land use that would have the effect of reducing soil losses and surface runoff.

Farm plans

On privately held arable lands, and to some extent on grazing and forested lands as well, the basic element in the structure of planning for watershed improvement is the farm plan. Every land user has some sort of plan. Most often it is not written down, and usually it is not even thought of as being a " plan " or as being related to the operations of a whole farm. Most often it is only a collection of habits and customs which result in a pattern of decisions made by the farmer. Haphazard as it may be, however, this pattern of decision making determines how the land will be used. The problem of the watershed improvement technician is thus to develop some means for influencing this farm planning.

It is essential that watershed improvement work be built up from improvements in individual farm plans. The hydrologic behavior of a great watershed is in large part the result of the day-to-day actions of the hundreds or thousands of men who use the watershed's land for growing crops, grazing of animals, or production of wood. Changes in watershed conditions most often means changes in the operations of individual farms and this means changing the operating plans of these farmers.

These changes must be planned against the background of the economic and social objectives of the farmers. It is futile to suggest that a farmer adopt some soil and water conserving practice that will result in a lower income for his family. Similarly, realistic plans for watershed improvement must take account of the social standards and preferences of people. Values attached by people to land and water resources strongly influence the care given these resources. Similarly, values attached to animals often influence the extent of grazing.

The farm plans that are required for watershed improvement must be " whole-farm " plans. They must be related to land use and also to many other aspects of the operations of farms and the lives of farm families. Improvement of grazing land through reducing the number of grazing animals involves planning also for means at least to maintain the production of meat, milk, fibre or animal power. This may mean developing alternate sources of animal feed, or improving the quality of the grazing animals and these, if they are to be accomplished, must be planned in a workable manner. Similarly, a plan to improve the vegetative growth on grasslands by fertilizer use, and thus control surface runoff and erosion, raises the problem of some means for convering the grass into income to pay for the fertilizers required. Here again, planning of animal production enterprises becomes important. In any plan-

ning of changes in land use on farms, the proposed change must be thought through to the end of its effect upon the operation of the whole farm. This process of " thinking through " is what is meant by whole-farm planning.

Problem spot plans

These are really parts of the work plans for watershed programs. They relate to the more critical areas in a watershed from the point of view of runoff and erosion and for the most part they cover the actions to be taken by the public agency concerned with watershed improvement. These may be extremely badly gullied areas where the necessary land use improvement is beyond the means either of individual land users, or of private persons co-operating in a village improvement scheme. The plans for such areas are usually concerned with engineering devices for soil stabilization plus such improvements in vegetative cover as afforestation or grass seeding. The plans for these areas often do not provide for any use of the area for a period of some years as their hydrologic improvement is so important from the point of view of the entire catchment area that their rapid healing is more necessary than their use for such purposes as grazing, crop production, or wood production.

A most important aspect of problem spot planning is economic analysis. The remedial work on such areas is always expensive and great care must be taken to minimize the costs of the work. Where there is unemployed labor, work in such areas can often be planned as a contribution to the public welfare through providing employment. Still it is usually the case that great care must be taken not to " overinvest " in the improvement of these critical spots. In some cases, time can be substituted for costly structures, and provisions for eliminating the cause of the difficulty, as for example, excessive numbers of grazing animals may in time give the desired results.

Data Requirements for Catchment Area Planning

The kinds and amounts of data that are necessary for planning watershed improvement projects will depend in part upon the nature and purposes of the project. The special requirements of research work in small watersheds is discussed in another section. Where the scheme being planned is primarily a demonstration activity it may be necessary to collect somewhat more detailed information on the initial situation than would be required for a general project of watershed improvement. For this latter purpose the planning data needs seem to fall into the following categories:

1. meteorological information
2. hydrologic information
3. soils and land use data
4. economic and social information.

Enough information of these types must be collected so as to provide a basis for making an assessment of the present situation, developing a plan for correcting the existent watershed problems, preparing a forecast of the probable effects of the proposed works, and making some reliable estimates of the costs of the project.

Meteorological information

Emphasis should be placed on the collection of data on precipitation. This should include measurements of annual precipitation, its seasonal distribution, and the characteristic of typical storms such as duration, intensity of rainfall and the frequency of storms delivering various amounts of water. Information on temperature conditions is particularly useful where storm rainfall or runoff is associated with freezing temperatures.

Hydrologic information

Enough information on stream flow conditions must be collected so as to be able to construct hydrographs for storms of the size for which protection is to be planned. As a minimum there should be observations or estimates of rates of flow under a wide variety of storm conditions and for periods following storms. In addition, it is important that estimates be developed of the sediment load of the stream in question. Adequate information must be acquired to permit careful designing of structures particularly to provide adequate flood storage capacity for the " design storm ", to provide sufficient spillway capacity to assure the safety of each structure and to provide adequate silt storage so that each structure has an economically useful length of life.

Soils and land use data

A detailed soil survey is an essential for adequate planning of a small watershed project. The information which such a survey will provide will not only serve as a basis for assessing the present situation, but is basic for planning land improvement activities such as afforestation, grass regeneration, terracing and other means for controlling surface runoff and soil losses. A detailed soil survey provides most of the information for a determination of the erosion situation and the delineation of major silt producing areas. The information on soil types is essential in choosing species of grass or trees for planting on particular sites and such information is also useful in forecasting the possible changes in infiltration rates as a result of changes in vegetative cover conditions.

For purposes of planning and evaluating watershed improvement, a special type of land use classification is needed. This may best be described as a hydrologic efficiency classification and should be based on both soil characteristics and vegetative cover. The purpose of such a classification is to provide a means for estimating the hydrologic behavior of a watershed. On the basis of a set of site classifications an index for the entire watershed can be computed and this in turn can be correlated, through adjustment of the weighting values used, with data from the stream hydrograph.

TABLE 1. – A MODEL FOR A CLASSIFICATION OF LAND ACCORDING TO HYDROLOGIC EFFICIENCY

Soil group	Land cover group			
	1	2	3	4
A	Highly permeable soils of great depth covered with dense forest or tight sod of tall grasses *Index 100*	Highly permeable soils of great depth covered with medium to light forest with some surface litter, grasslands with unbroken sod of short grasses, cropland with solid cover of growing vegetation *Index 80*	Highly permeable soils of great depth of great depth covered with mutilated forest, overgrazed grasslands and crop lands with partial cover of growing vegetation *Index 40*	Highly permeable soil of great depth, essentially bare *Index 30*
B	Fairly permeable soils, deep to medium in depth covered with dense forest or tight sod of tall grasses *Index 80*	Fairly permeable soils, deep to medium in depth covered with medium to light forest with some surface litter, grasslands with unbroken sod of short grasses, cropland with solid cover of growing vegetation *Index 60*	Fairly permeable soils, deep to medium in depth covered with mutilated forest overgrazed grasslands and crop lands with partial cover of growing vegetation *Index 30*	Fairly permeable soils, deep to medium in depth, essentially bare *Index 20*
C	Soils of limited permeability and fairly shallow soils covered with dense forest or tight sod of tall grasses *Index 60*	Soils of limited permeability and fairly shallow soils, covered with medium to light forest with some surface litter, grasslands with unbroken sod of short grasses, cropland with solid cover of growing vegetation *Index 40*	Soils of limited permeability and fairly shallow soils covered with mutilated forest, overgrazed grasslands and cropland with solid cover of growing vegetation *Index 20*	Soils of limited permeability and fairly shallow soils, essentially bare *Index 10*
D	Soils highly resistant to infiltration and very shallow soils, covered with dense forest or tight sod of high grasses *Index 30*	Soils highly resistant to infiltration and very shallow soils, covered with medium to light forest with some surface litter, grassland with unbroken sod of short grasses, cropland with solid cover of growing vegetation *Index 20*	Soils highly resistant to infiltration and very shallow soils, covered with mutilated forest, overgrazed grasslands and croplands with solid cover of growing vegetation *Index 10*	Soils highly resistant to infiltration and very shallow soils, essentially bare *Index 0*

The correlated index will thus serve as a measure of the expected effects of land use changes on stream behavior. Progress in improvement of the watershed can also be measured by periodic re-surveys of soil-cover conditions in the watershed and recomputation of the watershed index [2].

A model of such a classification system is given above. The index numbers used are purely illustrative and appropriate numbers would have to be developed from research and investigations in each area where such a system is to be used.

In adapting the classification system to the needs of a particular area some adjustments will be necessary in the definitions. It should be noted, however, that the essential feature of the system is that it is a two-way classification in which there is allowance for the compensating effects of soils and vegetative cover. A dense

continued on page 129

[2] See SEIGWORTH, K. J. and OLSON, E. F., "Infiltration changes resulting from forest protection and management", *Journal of Soil and Water Conservation*, Vol. 12, No. 6, November, 1957. A system of this type is described as used by the Tennessee Valley Authority in the United States of America.

Mobile Forestry Exhibit in Ethiopia

FIGURE 1. – *The first two panels of the exhibit showing how it was erected. The first panel features the portrait of the Emperor and his statement: "We shall plant a tree and set an example to you in planting it".*

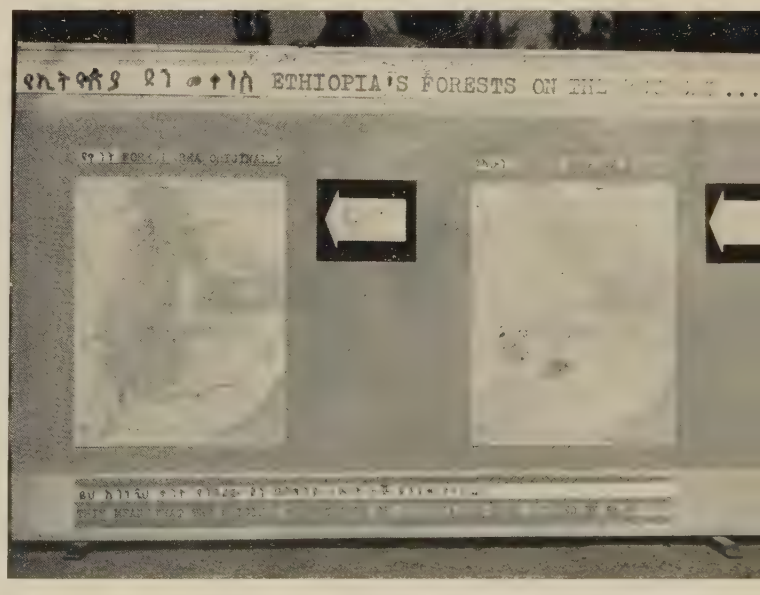
A SIMPLE, inexpensive, easily transported and adaptable forestry exhibit was evolved by an FAO Technical Assistance officer, for display on the occasion of a national Tree Festival in Ethiopia, with the ulterior objective of widespread use among the youth of the country, ranging from children in primary schools to students of University level.

The aim of the exhibit was to create public awareness of forest destruction by fire, by uncontrolled cutting and by nomadic agriculture, of the consequences in terms of soil erosion by water and wind, spread of arid conditions, shortages of timber, irregularity in water supply and the danger of floods (panels 1-12). The remaining panels (13-24) emphasized the stages necessary for forest development, and notably professional training at all levels, research, protection of existing resources and extension of the forest cover by afforestation, improved utilization and management, and the co-operation of the general public in assisting in the practical application of a national forest policy.

The 24 fibreboard panels were mounted on U-section metal frames and tubular iron supports. The whole exhibit is easily packed in two crates weighing a total of 400 kilos and can easily be accommodated on a Jeep trailer.

After it had been seen by schools, the children were asked to write essays on the subject of the disappearance of their national forests and the consequences of forest destruction. A direct result of the exhibit was that the Ministry of Public Instruction decided that the school curriculum for children of 12 years and over should include classroom teaching on the principles of conservation, and practical training in nursery work and tree planting.

FIGURE 2. – *Panel 2 spotlights the disappearance of Ethiopia's forest cover by contrasting, on adjacent maps, the original natural distribution of forest, some 500,000 square kilometers or 48 percent of the land surface, with its present area of 72,000 square kilometers or 6 percent of the total area of Ethiopia.*



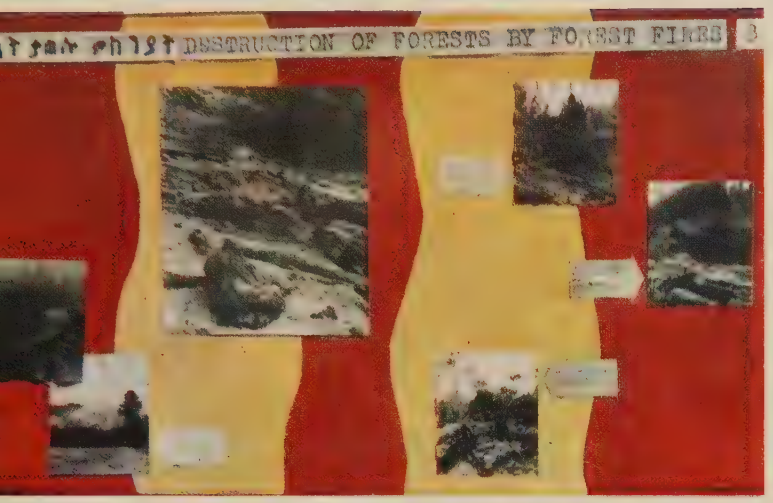


FIGURE 3. – *Panel 3 illustrates, both by photographs and by the use of color background, the destructive effect of fire on forest resources. The second of the destructive agencies is uncontrolled felling.*

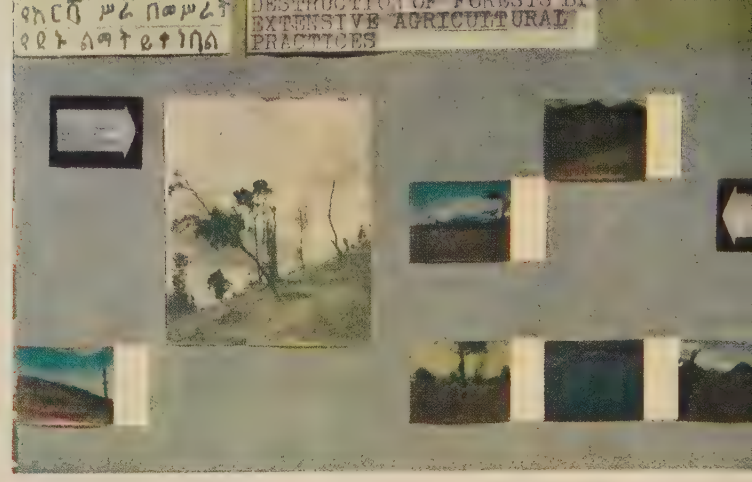


FIGURE 4. – *Panel 5 is a good example of the use of photographs on a grey background (symbolizing bare, arid ground) in illustrating the third factor in forest destruction, that of unsound and extensive agricultural practices often followed by overgrazing.*

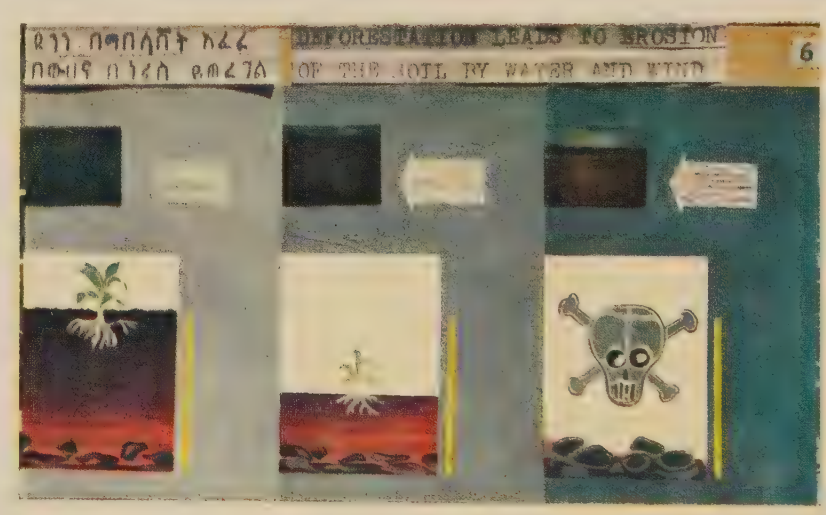


FIGURE 5. – *Panel 6 illustrates the stages in intensity of erosion by color gradation and a combination of actual photographic evidence with graphic representation of the degree of severity of each stage, from an aerial photograph of forest land and the sketch of a fertile soil profile to total erosion down to bare rock.*

FIGURE 6. – *Panel 8 shows, in graphic form, the effect of windbreaks in reducing evaporation and desiccation, and in increasing crop yields and farm incomes.*

FIGURE 7. – *The fact that indigenous timber can replace imported material, and that it is cheaper, is illustrated in Panel 9 by photographs, line drawing and local currency. The title, "Deforestation leads to timber shortage," summarizes the lesson to be drawn from this panel.*

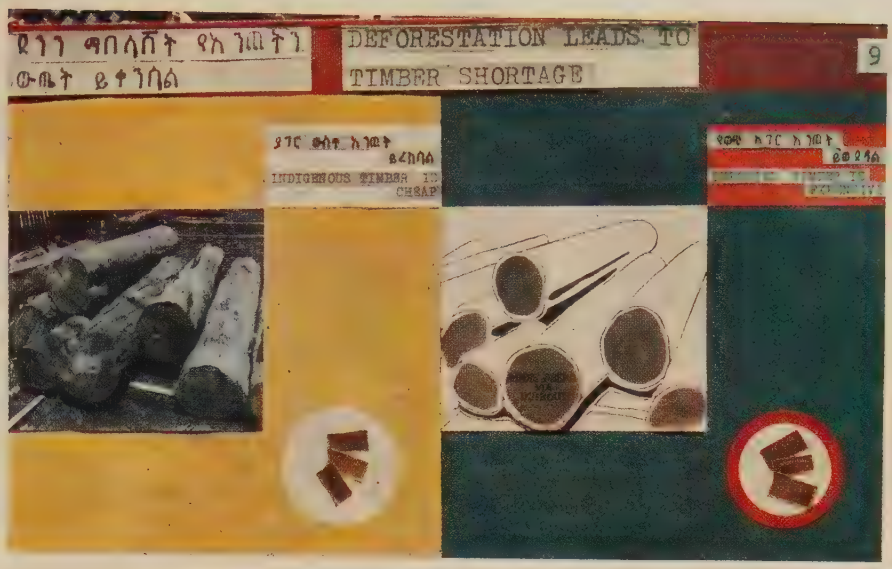
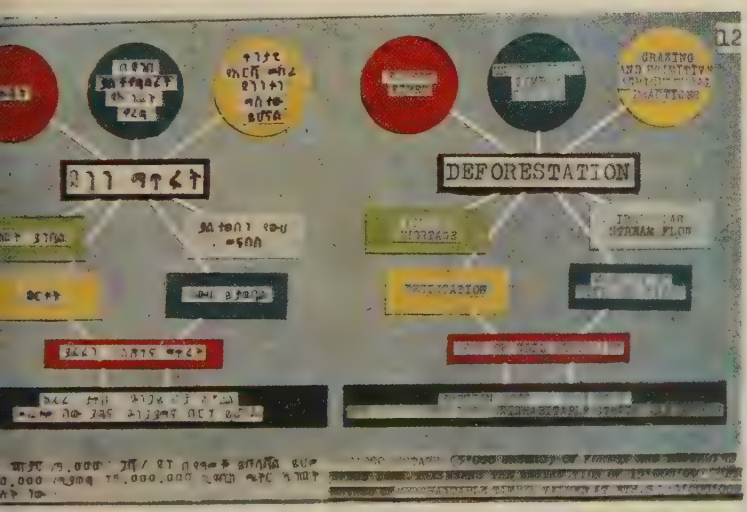


FIGURE 8. – *The background of Panel 10 is another good example of the use of design in drawing immediate attention to the theme it illustrates, namely that of the irregularity of moisture availability. A similar backcloth would be effective in showing the destructive effect of water erosion, and the fact that deforestation leads to flooding, which is the subject of Panel 11.*

FIGURE 10. – *After dealing with aspects of professional training and research, Panel 16 here shown illustrates protection and conservation, before passing on to others that deal with optimum afforestation and what this involves, to sound utilization and its benefits to the nation, and to the phases necessary in the formulation of management plans.*

FIGURE 9. – *Panel 12 is a schematic summary of the causes and effects of deforestation and concludes the first half of the exhibit. The next 12 panels, beginning with a summary, similarly presented, of the steps in forest development, goes on to illustrate these individually.*



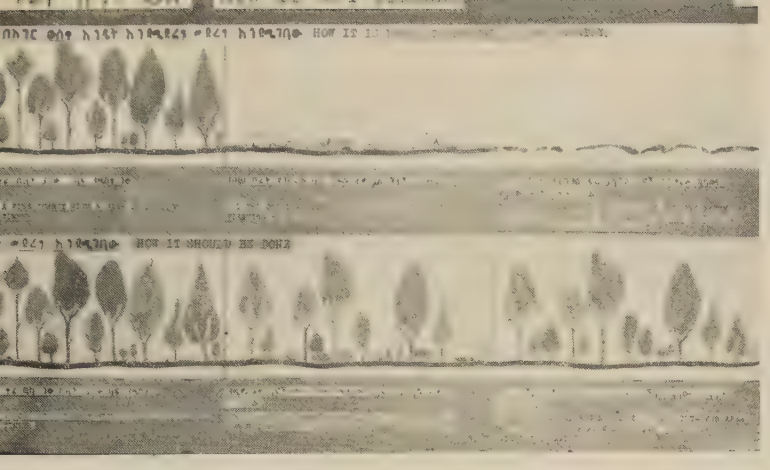


FIGURE 11. – *Panel 20 is the "text book" illustration of good and bad felling practice where natural regeneration is relied upon to reforest the area.*

FIGURE 12. – *On the question of soil conservation, the two diagrams illustrate the same topographical area in its present eroded condition in Ethiopia, and the way it would look under proper land usage.*

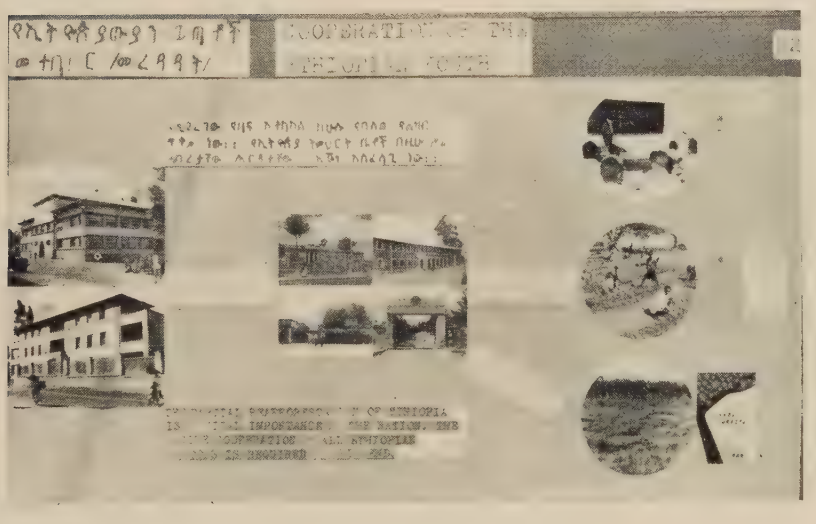


FIGURE 13. – *Panel 22 is an important one in connection with the objectives of the exhibit, in that it shows the role that youth, through school activities, must play in helping the nation achieve the necessary forest development and extension envisaged.*

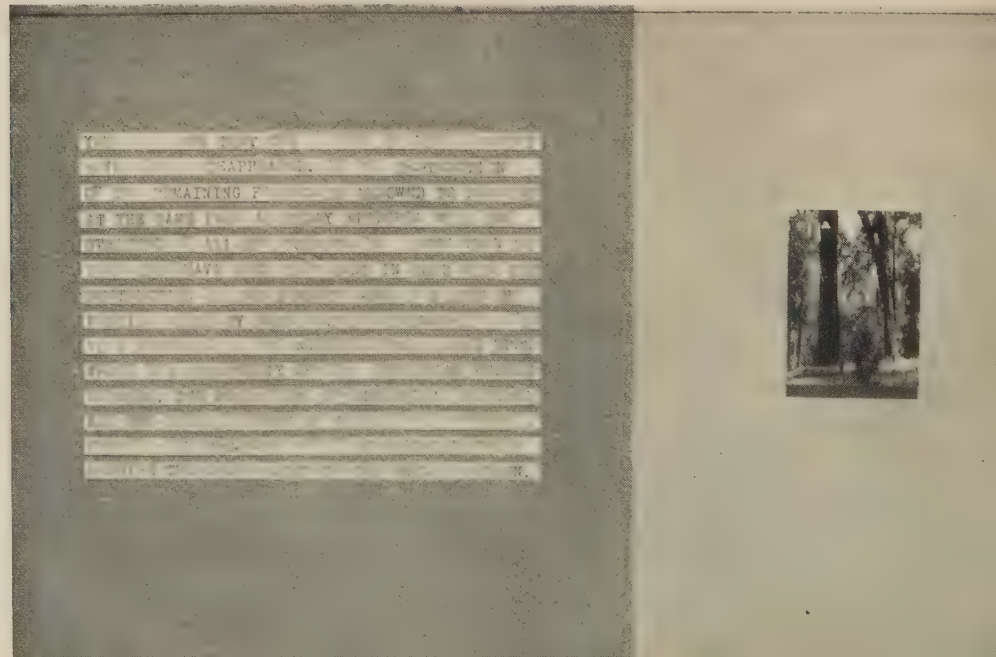


FIGURE 14. – *Panels 23 and 24, one in Amharic and the other in English, summarize the warnings contained in the first part of the exhibit and make an appeal to the individual and the nation for co-operation in halting forest destruction and making good the deficit so far incurred.*

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vegetation is to some extent a compensation for a soil of limited permeability and, on the other hand, the infiltration characteristics of the soil may offset to some extent the vegetative conditions. It is to be expected, however, that soil characteristics will be relatively unchanged over the life of a watershed improvement project while vegetative conditions may be substantially altered. Therefore, in making periodic reassessments of progress being made, it should be necessary only to collect new information on cover conditions which can be combined with the previously collected information on the soils. It will usually be found desirable to use some kind of reliable statistical sampling for these surveys.

Economic and social information

For purposes of watershed project planning a certain amount of economic and social data is essential. Some knowledge of the social structure of the area is important as a basis for planning means for enlisting full local co-operation in the work. In areas where settlement is organized on a village basis no special enquiry may be necessary to define the primary social groupings or to gain understanding of the leadership structure in the communities. On the other hand in areas of open settlement some effort at community delineation and leadership identification may be necessary. Standard sociological research techniques may be used for these purposes.

Considerable attention should also be given to collection of information on the organization of farming enterprises and to the economics of land use, whether for arable farming, grazing or forestry purposes. While it may not be feasible or necessary to make a comprehensive survey of every land holding in a watershed, it is essential to study the operations of a few farms typical of the area as to size and nature of farming. These studies should reveal the pattern of land use, the output of products and the cost and income position of the farm operator. Estimates should be made to reflect the effects on the farm of changes in land use such as would be made through the watershed program. Comparisons, particularly of the income estimates with data on present income situations for typical farms, will give useful indications of the probable attitude of individual farm operators toward making the land use adjustments required on their farms in the interests of watershed improvement.

Similar studies of private forest enterprises and of grazing operations would be equally valuable.

The data requirements for evaluation of the economic feasibility of a watershed improvement scheme will depend upon many things, but particularly upon the policy of the Government so far as such evaluations are concerned. In some countries procedures for such evaluations are prescribed in detail in either the authorizing legislation or in government policy directives. It should be noted that procedures developed for use in countries where there is a wealth of technical help and of technical data may be far too elaborate for use in less well-developed countries. Persons interested in the general problem of project evaluation will be well advised to study the special literature on that subject.

As a minimum for a watershed improvement project there should be a careful estimating of the public costs of the scheme and a description of the estimated effects of the work, both upon the behavior of the water of the catchment and also upon the income situation of persons using the watershed lands.

The Planning Process

The process for making a watershed plan will vary, depending primarily upon the nature of the watershed development envisaged, and upon the extent to which local interests and local participation are involved. It will be affected also by the structure of the government services responsible for watershed improvement work. If all the technical services involved in watershed development are centered in a single bureau or agency of the government, the process of project planning will be much simpler than if several agencies are each responsible for a part of the work. For example, a department of mountain lands, responsible for all kinds of land development and management in mountain areas will find it easy to make catchment area improvement plans. When responsibility for such lands is divided among various agencies such as a forest service, soil conservation service, community development service and animal production agency, the process for making integrated plans for development of watershed areas will be quite difficult.

This problem is most easily resolved in the legislative enactments authorizing watershed improvement work. In the law, the planning responsibility can be specified. An organization of government that is to carry on a great deal of watershed improvement work has need for a project planning staff. The size and composition of the planning organization will depend upon the amount of work to be done. Where a very large program is envisaged, a central staff and field organization are required, but where the number of projects is to be small, a central staff may be in position to handle all the project planning work alone.

In general, the planning work may be divided into two lines of activities. These are preliminary studies, and project plans. In most cases the planning costs of a project are considerable and it is useful to make a reconnaissance, or preliminary study, of an area first, so as to have a basis for a decision as to whether to proceed with detailed planning. The reconnaissance study may be initiated at the request of interested land users, or at the direction of the head of the responsible agency. Usually a few weeks are required to collect some information on the nature and extent of the land use and water control problems and to develop some expert judgments of the feasibility of an improvement program. A very short report, describing the present

situation, outlining the improvement program and making a first estimate of the costs of the work is prepared and submitted to the authorities, who can decide whether detailed project planning should be initiated. In some cases this kind of decision can be made by the head of the agency that is responsible for watershed improvement, but sometimes such decisions must be referred either to a ministerial level, or even higher in the case where several ministries are likely to be involved in the improvement work. In some countries the preliminary or reconnaissance report is the basis for public meetings in the catchment area for the purpose of assessing the extent of local interest in the proposed work, the extent of willingness on the part of landowners to make the necessary private investments required for land improvement, and the attitude of local persons toward any necessary control over land uses such as grazing and forest cutting.

The preparation of a detailed development plan for a catchment area may take several months. If no detailed soils survey is available for the area, it should be made. Similarly, engineering surveys of various kinds must be made if appropriate data are not available. For example, rainfall and runoff data must be collected, engineering studies of the stream channel should be made, sites for structures tentatively located and necessary foundation examinations made. Sites for channel improvements should also be located and the nature of these improvements outlined. Similarly, the necessary land use survey should be made, both as a basis for planning the land use changes and to establish a benchmark for measuring future progress of the program.

With all these data in hand, the program of watershed improvement can be worked out. Sufficient design work should be done on the engineering features of the project to permit development of reliable cost estimates. Plans for land use changes should be made in sufficient detail to indicate the specific nature of the adjustments to be made and the procedures and techniques to be used in making the changes. For example, the afforestation plan should specify the areas to be planted, species to be used, number of trees required, planting dates, site preparation work to be done, provisions to be made for prevention of grazing or burning of plantations, and an estimate of the costs of the work. For land use improvements on privately operated farm lands the plan should specify the nature of the work to be undertaken in each land use class, the actions to be taken by the government agency or agencies, the contributions to be made by private land users, the procedure to be followed in planning the work on individual farms, the nature of agreements to be made between the government and the individual land users, the financial contributions to be made by the government, and a schedule or timetable for the work over the entire catchment area.

When the planning report has been drafted by the field team it should be reviewed by the responsible senior officials of the agency or agencies that will carry out the development program. For watershed areas in which there is any amount of land in private use, the final project plan should reflect the views of responsible local leaders. The implementation of the plan will be made easier if such persons have an opportunity to participate in the project planning. In some cases, considerable effort is usefully devoted to encouraging contributions to project planning by local persons in order to generate a feeling that the project is essentially a local effort and not something being imposed upon by a distant government. For this purpose a local watershed improvement association is often useful. In other cases a local project advisory committee may be used. In still others the informal advise of a few local leaders may be sought.

The process of final approval of watershed development plans should involve some sort of review by all the public agencies with responsibilities for aspects of land and water development in the area. Attention should be given to the design of a system of clearance of planning reports that will minimize the loss of time and at the same time give all interested parties an opportunity to comment.

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The World's Forest Resources

FAO Staff

FAO has just published, under the title World Forest Inventory 1958, *the results of its third quinquennial inquiry. The following pages reproduce most of the text of the introduction to that publication, together with a selection from the summary tables.*

A sound national forest policy aims at the rational development and exploitation of forest resources on the principle of the greatest good for the greatest number. To formulate such a policy, as precise a knowledge as possible of the wood resources of the country is required. These data a forest inventory must provide. To furnish all the elements necessary for policy formulation, the inventory should yield information on the forested area, ownership, composition and management status, as well as estimates of the volumes of standing timber, annual growth, fellings and removals.

"Two factors give rise to the need for world-wide inventories. First, the population of the world is increasing steadily, on average by one and a half per cent annually; forest resources, on the other hand, are in the short term relatively fixed, at any rate in extent. On a world scale efforts are necessary to ensure that forest output rises commensurately with world needs. Secondly, forest needs are by no means co-terminous with forest resources, since the factors which determine forest distribution transcend political boundaries. Hence the need arises for the co-ordination of national forest policies. In other words, the peoples of all nations and regions are becoming increasingly conscious of their interdependence, of the existence of 'one world.'

"FAO is alive to this, and not only because the forests are a repository of important raw materials, but also because they play a decisive role in agricultural economy by protecting crop lands and regulating the water regime. Thus a knowledge of the world's forest resources is vital to the execution of the program of FAO in its broader aspects, and not merely to that of its Forestry and Forest Products Division alone."

With these words FAO prefaced its publication of the results of the 1953 World Forest Inventory.[1] These words, still valid, succinctly express the nature and purpose of an inventory of world forest resources and the reasons why FAO has assumed responsibility for carrying out such inventories. They may therefore serve to introduce the present publication.

When the Conference of FAO, at its sixth session, in 1951, recommended that the Organization should, at five-year intervals, collect and publish available information on the forest resources of the world, it recognized that this kind of inquiry must be repeated at intervals. Not only are forested area, growing stock, growth and fellings constantly changing under the impact of a variety of technical, economic and social factors; national statistics are steadily improving — extensively and intensively. In many countries the area covered by the national inventory increases year by year, while new methods of stocktaking give more detail and greater precision. Aerial photography, with improved equipment, allied to ground surveys, making use of modern sampling methods, has made it possible for many countries with limited funds at their disposal for inventory work to step up the rate at which their national inventories are being conducted. In many cases they have been able to obtain technical help, from FAO or from countries operating bilateral technical assistance schemes.

Preparations for this third world forest inventory followed the lines established for the previous inventory. The advice of an expert group was sought on the scope of the inventory and on the definitions to be employed. Helpful comments on a draft questionnaire were obtained from experts in all regions. The forms finally agreed were despatched to all member countries, including dependent territories, and transmitted to several non-member countries. Meanwhile FAO staff assembled information from various official and unofficial sources concerning the resources of other non-member countries.

A hundred and forty-three countries, representing 88 percent of the world forest area, replied to these questionnaires. In the 1953 inventory replies were received from 126 countries, representing 73 percent of the world forest area. Not all the replies were complete, and the information received was therefore supplemented with the aid of authorities in member countries, FAO Technical Assistance field experts, official reports and, all else failing, by recourse to the 1953 and 1947 reports.

The sources of information for the 1953 and 1958 inventories are summarized in Table 1. If it is borne in mind that the official statistics on which a substantial part of the 1953 inventory rested were in many cases considerably out of date, it is clear that the present inventory has a greater claim than its predecessors to provide a comprehensive picture of the extent of the world's forests.

The introduction to the report on the results of the 1953 world forest inventory explained in some detail

[1] *World Forest Resources*, FAO, March 1955. Results of the first inventory (1947) were published in *Unasylva*, Vol. II, No. 4, 1948, and Vol. IV, No. 2, 1950 under the title "Forest Resources of the World."

Table 1. – Information Sources

Source	1958 inventory		1953 inventory	
	Number of countries	% of world forest area	Number of countries	% of world forest area
Replies to:				
1958 questionnaire	143	88		
1953 questionnaire	13	2	126	73
1947 questionnaire	5	2	10	3
Official statistics	34	5	57	24
Unofficial reports	15	3	5	—
Total	210		198	

why it had not proved possible to compare the 1953 figures with those reported in 1947. It went on to say: "The steady progress now being made, together with increasing uniformity in approach and clarity in definition, offer the hope that valuable conclusions may be drawn when the results of the 1958 inventory are compared with those of the current one." This hope has been only partly realized. For whereas in 1955 it was expected that the pattern of future world inventories would not depart substantially from that established in the 1953 inventory, certain changes were in the event deemed desirable by the experts who met to determine the scope of the 1958 inquiry. These changes, and the reasons for them, are discussed in some detail below. Some of them undoubtedly had the effect of reducing comparability between the successive inventories. This, however, is certainly not the main ground for non-comparability. Much more important is the impact of improvements in national statistics. Some examples of the effect of these changes are given in the pages which follow.

What must never be overlooked, in interpreting the figures which appear in the tables and text which follow, is that none of the component elements of the statistics are more precise or up to date than the national inventory data on which they are based. Carrying out a national forest inventory is a long and costly business. How long and how costly depend not only on the types of forest to be surveyed, but also on the amount of detail which the national forest authorities require. Each authority, in devising its inventory plans, has to compromise between the intensity of the inventory and the area to be covered on the one hand, and the funds available and the time by which the results are required on the other. Even relatively wealthy countries, with a keen awareness of the significance of their forest resources and with sizeable funds available for inventory work, have to effect some such compromise. Some have had recourse to a continuous inventory, whereby a given area is surveyed each year, the total forest area being covered in a 10- or 15- year cycle, the cycle thereafter being repeated. The partial results flowing in each year can, of course, be used to arrive at more accurate assessments of national totals.

In other countries, the inventory may be tailored to meet the most urgent national needs. For example, relatively sparse information may be sought concerning the total forest area — perhaps merely location and extent — but more intensive information (species, age, or diameter distribution, growing stock and growth) for those areas where exploitation is currently taking place or is contemplated in the near future. In general, most of the national inventory data are estimates based on partial inventories. For very many countries of the world a complete inventory does not as yet exist.

Moreover, a national inventory must try to elicit answers to a number of questions relative to the formulation of national forest policy which a world inventory cannot hope to cover. The world forest inventory confines itself to ascertaining a limited range of salient facts, which can provide a general picture of the nature and extent of the world's forests, the wealth of resources they contain, and the modifications they are undergoing under the influence of man.

Scope of the Inquiry

In designing the 1958 questionnaire, the secretariat and the advising experts had clearly in mind the desirability of preserving continuity with earlier inventories. At the same time, a detailed examination of the results of the previous inventory made it clear that a number of changes were needed. In some cases replies received had shown the need for greater clarity in the definitions adopted to ensure that the recipients of the questionnaires were in no doubt as to the information required. In other cases a perusal of the 1953 replies showed that the information sought could not be readily supplied by most countries at the present stage of development of national forest inventories. It was therefore necessary to revise concepts (as distinct from definitions) in order to elicit information which would be both more meaningful and easier to furnish. In addition, the inadequate response to certain questions in 1953 led to the omission of these questions in 1958. Finally, it was decided to insert one or two new questions intended to throw additional light on the potential value of the forest resources reported.

Inevitably some of these changes, which are discussed in detail below, have affected comparability with the previous inventory.

The 1958 inventory includes information falling into the following main groups:

Forest area in relation to other land categories

Accessible forests: area and ownership

Forests-in-use: composition, management, growing stock, growth, fellings and removals

Other roundwood sources

Changes in forest area.

In the 1958 inventory *forest* is defined with somewhat more precision than hitherto. Thus, bamboo lands and wattle (*Acacia* spp.) plantations are specifically included, while savanna types with an average density of tree cover below 0.05 are excluded, as are nonforest crop lands such as rubber and cinchona.

In the earlier inventory many respondents experienced difficulty in deciding whether or not fuelwood cutting for local domestic use, which is widespread in all regions of the world, warranted the classification of forests as " in use." They were given further guidance in the 1958 inventory by the following note:

> " *Note on fuelwood:* Although nearly all forest lands are capable of producing some fuelwood, and are often used to some extent for that purpose, the utilization of forests for occasional smallscale fuelwood cutting does not place them either in the " accessible," " forests-in-use," or " productive " classes. The exact delineation of these classes will vary somewhat between countries and will be determined by the competent authorities in each country. "

The amplified notes in the 1958 inventory on *forests* and *fuelwood* did not stem from any change in concept, but were designed solely to give greater clarity in the definition. Even so, depending upon the interpretations accorded by respondents in the previous inquiry, areas may be included in the present inventory which were excluded in 1953, and vice-versa.

The 1953 inventory questionnaire sought a subdivision of the area of *forests-in-use* into those with a predominantly *economic* character and those with mainly *protective* functions. The distinction was not a happy one, carrying as it did the implication that forests which serve primarily a protective role are " noneconomic." In fact, of course, the protective functions of the forest are strictly economic, though their evaluation in monetary terms often presents considerable difficulty. More important, however, was the fact that relatively few countries were able to draw this distinction. On the other hand, it was clear that more and more countries, intent upon assessing the potential of their accessible forests, are attempting to distinguish broadly between those which they deem *productive* (producing or capable of producing usable crops of wood or other forest products) and those deemed *unproductive*. For the 1958 inventory, therefore, this classification has been adopted as being at once more meaningful and more readily available. Here the present inventory provides new and valuable information.

The definition of *accessible* forests has also been changed. In the 1953 inventory these were defined as forests " now within reach of economic management or exploitation." Whether a forest is presently within reach of economic management or exploitation is not an easy matter to decide. Moreover, a rise in the price of wood could in some instances make considerable areas of forest " accessible " in this sense, while a price fall could relegate forests to the inaccessible class. Evidently, a definition so vulnerable to short-term fluctuations and so subject to individual interpretation had to be discarded. Instead, the 1958 inventory defines accessibility in purely physical terms: " areas within reach of exploitation by existing transportation systems." The revised definition is not, of course, itself immune from objection. Clearly, different forest authorities will interpret it in different ways and it would be unwise to attach any great importance to inter-country comparisons. However, it does afford forest authorities the possibility of furnishing figures which are consistent in successive inventories.

Questions asked in 1953 but discarded in 1958, either because the response was poor or because the information supplied did not lend itself to compilation, relate to the distribution by size of individual privately-owned forests and to the species composition of growing stock in forests-in-use.

The World Forest Inventory naturally concentrates attention upon forest areas. Forest area alone, however, can convey a very misleading impression of the potential of the forest resource. There is obviously need for some indication, however approximate, of the quality of the forest. This point was stressed in reporting the results of the 1953 inventory, where it was noted that " in many parts of the world — in Africa, for example — dense forests shade off into open stands with a continuous sheet of grass, finally passing into shrub and thorny formations. Where does the forest end and brushland begin? The answer to this question frequently depends on local administrative convenience, so that areas classified as forests may in fact bear only a few small and deformed trees per hectare, along with scattered thorny shrubs of no economic value. Grazing grounds, whether grazed by wild or domestic animals, if they occur within the forest area, are more often than not classified as forest since they usually come under the supervision of the forest administration. Thus the term *forest* in this inventory covers stands of very different densities."

The revised definition of *forests* in the 1958 inventory, already mentioned, to some extent sharpens the picture the inventory gives us of the forested area, by specifically excluding land with very low timber cover. In addition, a tree cover section asks countries to report the proportions of the exploited forest area in density classes.

The important role played by bamboo in the forest and timber economies in many Asian countries led to the inclusion for the first time of questions on the area of bamboo forests and the volume of bamboo removals.

In previous inventories attention was centred on the forests-in-use, the forests which are naturally best documented and for which national forest authorities are able to provide most detailed information. Yet a number of questions were asked about the inaccessible forests. The results showed, however, that relatively few countries were able to furnish the information requested. In the 1958 inventory, therefore, questions on composition, growing stock and increment in inaccessible forests were discarded, and instead a broad classification into productive and unproductive (as defined earlier) sought. As in the preceding inventory, countries were asked to indicate the area which had become accessible in the course of

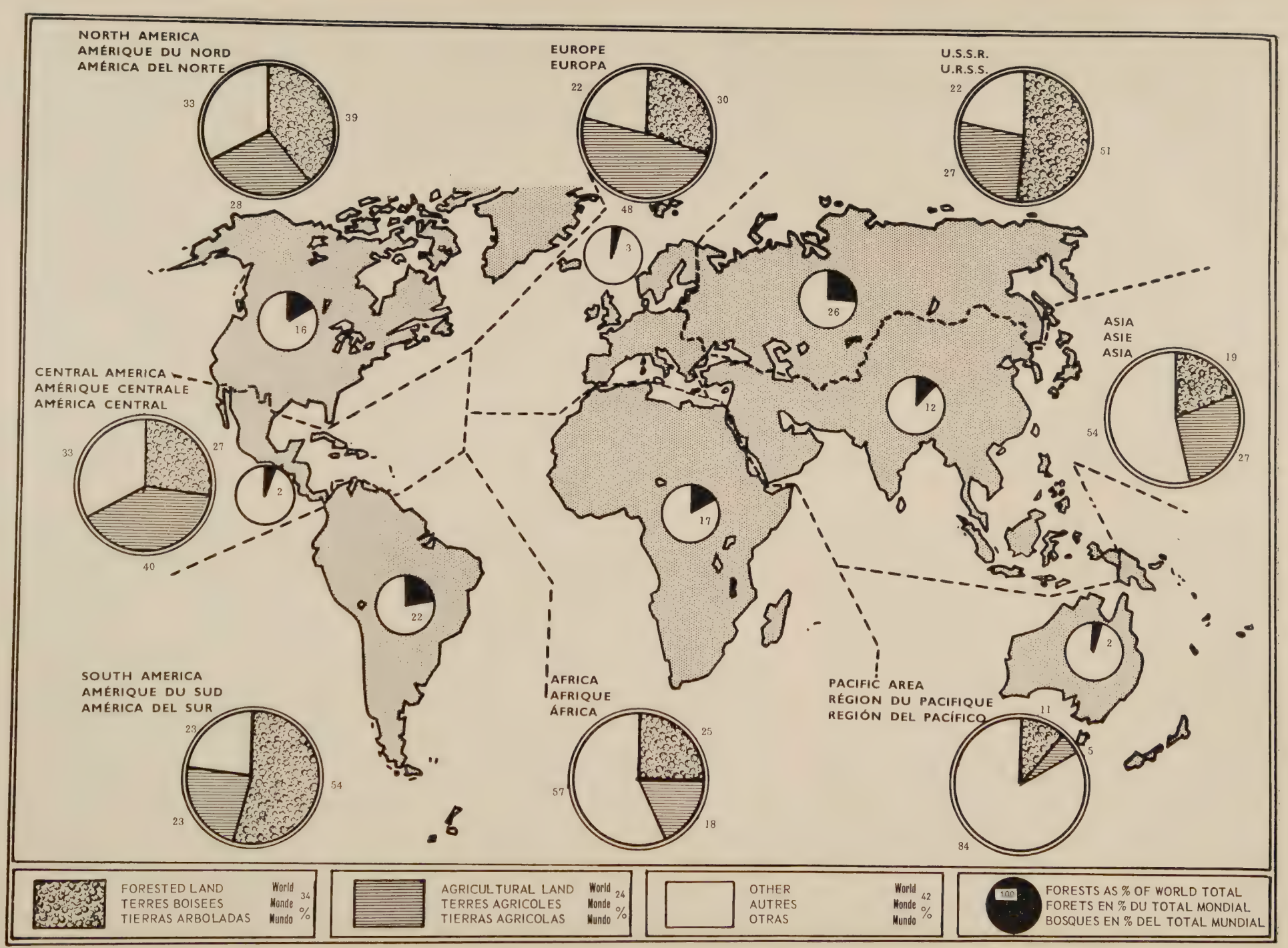


FIGURE 1. – *Land classification.*

the preceding quinquennium, and an estimate of the area expected to become accessible in the near future. This last question, however, was this time limited to the inaccessible *productive* forest, and covered a 10-year, instead of a five-year, period.

These changes, too, were designed to elicit more useful information about those categories of forest resources which, on paper, represent potential wood reserves — i.e., the forests presently inaccessible and accessible forests not yet in use. For the same reason, in the section relating to changes in forest area, a question was asked on the estimated area of productive forest which was deemed to have become unproductive during the preceding quinquennium.

To throw light on the impact on the forest of shifting cultivation, widespread in Asia, Africa and Latin America, countries were asked to state separately growth losses due to this cause.

Finally, the sections of the questionnaire relating to the wood harvest were elaborated in order to secure data that might help to fill certain evident gaps in present information. Thus not only were particulars sought of recorded removals in forests-in-use and from trees outside the forest, but additionally, estimates were requested of the volume of removals not recorded in forests-in-use and also of removals from forests other than those classified as in use. In all cases, the questions related to fellings, losses in logging and transportation, and removals — not because it was expected that data would be available for each of these headings in every instance, but to serve as a useful reminder of the distinction between fellings (drain on the forest) and removals (wood supply).

These would seem to be a fairly formidable list of changes, given that the designers of the present inventory were anxious to retain as far as possible comparability with its predecessors. However, none was lightly introduced, and it was the firm belief of those preparing the questionnaire that each of the changes, the reasons for which have just been explained, would improve the quality and usefulness of the information received. In the light of experience gathered to date, it would be rash to claim that the scope and coverage of this periodic inquiry will not change in the future. Indeed, so long as the progress in improving national statistics continues at its present rapid rate, there is something to be gained from retaining a measure of flexibility in the form of the questionnaire. The argument for comparability is strong; but it cannot be decisive so long as the magnitude of changes due to statistical improvement obscures the real changes which are taking place in the forest. National forest inventories are not as yet sufficiently established to warrant casting a periodic world inquiry into a definite and final shape.

When the results of national inventories are added together to arrive at regional and world totals, the ensuing figures are not completely homogeneous. The figures reported by countries are based on local concepts and definitions, adapted to national needs; these may vary considerably from country to country. But although the figures differ, they have one thing in common: they reflect broadly the current view of the national forestry authorities as to what is utilizable. Examples from the data for growing stock and for fellings will illustrate some of the differences.

In reporting the volume of growing stock, many countries include branches and tops but exclude stumps. Out of 102 countries for which growing stock figures were received, however, 34 *exclude* all branches and tops, and 34 others exclude branches alone or either branches or tops less than a given diameter. The growing stock estimates of six countries *include* the volume of stumps. Finally, some countries report only commercial species in their growing stock, or trees above specified diameters — which vary, for example, from 3 centimeters in Chile to 50 centimeters in Sarawak.

Table 2. – Components of Growing Stock Estimates, 1958

Category	Number of countries [1]	
	including in estimates	not including in estimates
All species	66	20
All ages and diameters	57	29
Stumps	6	80
Tops above merchantable diameter	44	42
Branches	17	69
Fuelwood	65	21

[1] Details not available for 16 countries.

The volume of fellings is of importance in the comparisons that are made between forest increment, allowable cut and the timber harvest. Most countries unfortunately report only the removals of roundwood, and the fellings cannot easily be derived because of insufficient data on logging and transport losses. Only 36 countries were able to report fellings and the attendant losses, out of 51 countries that gave some fellings data. No meaningful regional fellings could be calculated except for Europe. In the use of fellings and removals figures it must be remembered that the inclusion or exclusion of trees of varying diameter, and the differences in the handling of branches and tops in the statistics result in considerable variations in the totals. Furthermore, the bark factor is of considerable importance. Growing stock and increment are usually reported *with* bark, whereas, fellings and removals are *without* bark. The reports from countries usually, but not always, indicated whether bark is included or excluded. Conversions in which a bark factor must be applied are often necessary, and the bark factors used were the percentages reported by countries, or, where these were lacking, a general factor of 10 percent.

TABLE 3. – REPORTS ON DETAILS OF FORESTS RESOURCES, 1958

Region	Number of countries reporting	Number of countries providing data relating to:									
		Forest area	Ownership	Growing stock	Gross increment	Net growth	Allowable cut	Fellings	Removals	Afforestation	Lost areas
Europe	26	26	26	25	24	25	24	15	26	21	21
U.S.S.R.	1	1	1	1	1	—	—	1	1	—	—
North America	3	3	3	2	1	1	1	1	3	—	—
Central America	20	20	17	10	6	6	3	4	18	3	3
South America	11	11	7	4	3	2	1	1	9	4	4
Africa	41	41	39	29	20	19	15	18	39	28	27
Asia	28	28	27	24	15	18	14	9	25	17	15
Pacific Area	13	13	9	7	3	3	1	2	9	4	4
TOTAL	143	143	129	102	73	74	59	51	130	77	74

THE RESPONSE

The foregoing section has set out the scope of the 1958 inquiry, drawing attention to certain changes as compared with the preceding inquiry. It has also discussed some of the features of the data which limit intercountry comparisons. It may also be useful to give, first, an account of the extent to which countries were able to respond to various parts of the questionnaire and, second, a brief explanation of the way in which the data have been compiled and presented.

Of the 143 countries that were able to furnish data on forest area, most could also provide information on ownership and removals. More than half could give estimates of growing stock, but only half, or rather less than half, on growth and changes in forest area. Surprisingly few countries (51) provided estimates of fellings. Details of the response to the several categories of information sought are set out in Table 3.

In some instances the relative response was, contrary to expectation, lower than in 1953 — for example, on fellings. Some fall in relative response was, of course, to be expected, since the additional countries reporting on this occasion were, in several cases, countries where forest statistics are at an early stage of development. This, however, fails to explain why fewer countries have furnished information about afforestation and fellings. A careful scrutiny of the individual replies, however, leads to the following paradoxical conclusion: an increasing awareness of the statistical complexities has frequently discouraged countries from making estimates. Thus, on fellings, inhibiting factors have been a clearer understanding of the distinction between fellings and removals, and growing awareness of the importance of unrecorded fellings; and on afforestation, a consciousness of the fact that private, as distinct from public, afforestation is inadequately recorded. While it is perhaps understandable that increasing knowledge brings increasing diffidence — a phenomenon by no means confined to forest statistics — it is evident that a reasoned guess by the national forest authority, based on intimate knowledge of the forest resource, can provide figures of undoubted value for incorporation into regional and world totals. This is a point which will no doubt command particular attention when the next world inquiry is designed.

The information received on the 1958 questionnaires, after scrutiny and in many cases back-checking with the country, was assembled in eleven basic tables which form the bulk of the published report. It was possible to fill out these tables in a number of instances with other reliable official information — earlier inventory reports, published statistics, etc. All this information — i.e., appearing in the basic tables — is referred to in the text which follows as "reported data"; the reader will therefore bear in mind that throughout the following analysis "reported data" include some figures not derived directly from the current inventory.

The reported data have been summarized, for the convenience of the reader, in the series of text tables presented in the following section. Since, however, coverage is seldom complete, and moreover varies from region to region, these summaries of reported data in many cases fail to provide the reader with the indications of regional and world totals he is entitled to expect. Wherever possible, therefore, alongside the reported data have been presented secretariat estimates of these totals. In preparing these estimates, the secretariat has drawn on a wide variety of information, other than reported data, available to it. This information comes from many sources, is rather scattered and not always precise. It consists of reports by field experts, private publications, travel reports, and so forth: in short, information not of sufficient precision to warrant inclusion in the basic tables, but helpful in building up a broad regional and world picture. Where no indications were available, it was sometimes possible to argue by analogy from the facts known about a neighboring country where forest conditions are similar.

Such regional and world totals as are included, there-

WORLD ESTIMATES

In the following three tables, an attempt has been made to estimate world totals for some of the more important elements of the inventory. These estimates, since they are based mainly on reported data, encompass all those defects in the information submitted which have already been referred to. Further possibilities of error are introduced in assembling figures for those regions where response was low.

TABLE A. – CLASSIFICATION OF FORESTS

Region	Forest land										
	Total	% of land area	Per inhabitant	Accessible	Inaccessible	Conifers	Non-conifers	In use			Unexploited
								Conifers	Non-conifers	Total	
	Million hectares	%	*Hectares*	*Million hectares*							
Europe	141	30	0.3	138	3	84	57	80	55	135	6
U.S.S.R.	1 131	51	5.5	1 131	—	896	235	362	97	459	672
North America	733	39	3.8	400	333	497	236	252	148	400	333
Central America	74	27	1.4	55	19	16	58	4	10	14	60
South America	957	54	7.3	277	680	12	945	8	68	76	881
Africa	753	25	3.4	380	373	3	750	2	123	125	628
Asia	520	19	0.3	326	194	110	410	44	192	236	284
Pacific Area	96	11	6.5	26	70	8	88	4	16	20	76
TOTAL	4 405	33	1.6	2 733	1 672	1 626	2 779	756	709	1 465	2 940

TABLE B. – GROWING STOCK AND INCREMENT IN FORESTS-IN-USE

Region	Growing stock						Gross increment					
	Total	Conifers	Non-conifers	Per hectare			Total	Conifers	Non-conifers	Per hectare		
				Total	Conifers	Non-conifers				Total	Conifers	Non-conifers
	Million m³ with bark			*m³ with bark*			*Million m³ with bark*			*m³ with bark*		
Europe	10 780	7 120	3 660	80	90	65	330	210	120	2.5	2.7	2.3
U.S.S.R.	69 847	61 043	8 804	152	168	91	854	690	164	1.9	1.9	1.7
North America	36 640	27 140	9 500	100	135	60	820	470	350	2.3	2.4	2.2
Central America	1 080	330	750	80	85	80	35	10	25	2.7	3.1	2.5
South America	8 300	1 060	7 240	115	135	110	195	25	170	2.7	3.3	2.6
Africa	5 620	70	5 550	45	30	45	105	5	100	0.8	2.3	0.8
Asia	22 020	4 620	17 400	100	120	95	429	9	420	2.6	2.4	2.6
Pacific Area	1 320	220	1 100	65	50	70	35	9	27	1.7	2.0	1.7
TOTAL	155 610	101 600	54 010	110	145	80	2 799	1 428	1 371	2.1	2.2	2.0

TABLE C. – DISTRIBUTION OF FOREST RESOURCES

Region	Forests			Growing stock	Gross increment	Removals
	Total	Accessible	In use			
	Percentage					
Europe	3	5	9	7	12	18
U.S.S.R.	26	41	32	45	30	21
North America	17	15	27	23	29	25
Central America	2	2	1	1	1	2
South America	21	10	5	5	7	10
Africa	17	14	9	4	4	7
Asia	12	12	16	14	16	16
Pacific Area	2	1	1	1	1	1
TOTAL	100	100	100	100	100	100

Table 4. – Land Classification

Region	Forests			Nonforested land	Total land	Forests as % of land area	Forest *per caput*
	Total	Accessible	Inaccessible				
	Million hectares					%	*Hectares*
Europe	141	138	3	332	473	30	0.3
U.S.S.R.	1 131	1 131	—	1 103	2 234	51	5.5
North America	733	400	333	1 141	1 874	39	3.8
Central America	74	55	19	198	272	27	1.4
South America	957	277	680	818	1 775	54	7.3
Africa	753	380	373	2 225	2 978	25	3.4
Asia	520	326	194	2 198	2 718	19	0.3
Pacific Area	96	26	70	758	854	11	6.5
Total	4 405	2 733	1 672	8 773	13 178	33	1.6

fore, in no case result from a simple grossing-up of reported data on the basis of the percentage coverage indicated; they are built up country by country on the basis of reported data and a mass of miscellaneous information.

The reader will find these FAO estimates throughout the text which follows, as the different categories of information afforded by the inventory are discussed in turn. For his convenience, the main elements have been brought together in the world estimates: Tables A, B and C, which conclude the discussion of the results. In the published report the salient information is illustrated in six charts which precede the text. Two of these charts are published here.

Analysis of the Results

Forest areas

The regional distribution of the world's forests is summarized in Table 4.

Almost exactly one third of the earth's land surface is under forest; a further 24 percent is devoted to permanent agriculture. The remainder, 43 percent, consists mainly of uncultivated land, including brush lands and very sparsely timbered savanna areas. There is a widespread belief that nonforested lands not under cultivation are idle lands, having no economic function and representing in their entirety a potential resource for the extension of agriculture or of forest. There could be no greater misconception. These " wild lands " as well as the forests contribute to wood production and play an important part in preventing soil erosion, regulating stream flow, affording grazing and sheltering game. The uncultivated, non-forested lands thus frequently have extremely important economic functions and their value may be as great or greater than similar areas of forests managed primarily for timber production. The management of all or part of these uncultivated lands is entrusted in many countries to the forest authorities.

A fourth of the world's forests are located in the U.S.S.R. and over one fifth in South America. These two regions also have the highest proportion of land area covered by forest — 54 percent in South America, 51 percent in the U.S.S.R. The Pacific Area, with 11 percent, has the lowest percentage of forested land. The uneven distribution of the world's forests, however, is more evident when considered in relation to the population the forests have to serve. Thus South America at one extreme has 7.3 hectares of forest per inhabitant, while, at the other, both Europe and Asia have only 0.3 hectare. Since Asia accounts for 56 percent of the world population, the average for the world as a whole is 1.6 hectares.

About three fifths of the world forest area is deemed accessible — within reach of exploitation by existing waterways, roads, railways or other means of transportation.

Though very little forest area remains inaccessible in Europe, 71 percent of South American forests are still beyond reach and vast areas remain inaccessible in Africa and Asia. It should be observed, however, that forests in North America and the U.S.S.R. are not classified as to accessibility in the sense used in this inventory. The figures included in the Table for these two regions should therefore be treated with reserve, as should the world total.

Of the 2,700 million hectares of forest today physically within reach of exploitation, only slightly over half (1,465 million hectares) is presently in use. Very substantial areas of unexploited but accessible forest remain in South America and Africa, relatively small areas in Europe and the Pacific Area. Noteworthy is the fact that 72 percent of Asia's accessible forests is already being exploited.

There is a tendency to look upon the accessible but still unexploited areas of forest as the primary reserve from which rising timber requirements will be met in the years to come. The suitability of these forests for exploitation depends very largely upon what they contain, and undue concentration on the areas apparently available can be misleading. Generally speaking, these forests

Table 5. – Accessible Forests

Region	Reported data			Estimated totals		
	Total	In use	Not exploited	Total	In use	Not exploited
	Million hectares					
Europe	138	135	3	138	135	3
U.S.S.R.	1 131	459	672	1 131	459	672
North America	400	400	—	400	400	—
Central America	53	12	41	55	14	41
South America	277	76	201	277	76	201
Africa	339	106	233	380	125	255
Asia	313	229	84	326	236	90
Pacific Area	25	20	5	25	20	5

are less well stocked, and stocked with less desirable species, than those which have already been taken into exploitation. Moreover, in several regions of the world, population pressure will in the coming years compel the alienation of some of these lands to agriculture. Finally, this category of forest undoubtedly includes considerable areas where exploitation will need to be prohibited or restricted if their protective functions are not to be impaired. As will be seen later, many of the forests presently in use are underexploited, and it is likely that efforts will tend to concentrate on securing enhanced yield, improved harvest and better utilization.

Ownership

The inventory provides fairly reliable information on the ownership of accessible forests. Over three quarters of the world's accessible forest land is publicly owned, either by the state (64 percent) or by other public entities (12 percent). Private ownership is most marked in Europe (55 percent), South America (45 percent), and North America (43 percent).

Table 6. – Ownership of Accessible Forests

Region	Coverage[1]	Forms of ownership[2]		
		State forests	Other public forests	Private forests
	Percent			
Europe	100	33	12	55
U.S.S.R.	100	95	5	—
North America	100	18	39	43
Central America	23	50	10	40
South America	88	55	—	45
Africa	89	65	21	14
Asia	96	84	9	7
Pacific Area	99	59	1	40
Total	95	64	12	24

[1] Area of accessible forests for which ownership data were reported, divided by total area of accessible forests.
[2] Reported countries only.

Some information is also available, though it is not included in Table 6, on the importance of farm forests. These account for about 55 percent of the privately-owned accessible forest lands in Europe, 45 percent in North America, 25 percent in Asia and about 80 percent in Africa. Reports from South America and the Pacific Area are too fragmentary to provide a good picture of farm forest area in these regions.

In reporting on the 1953 inventory it was observed that "in the less developed regions, especially in the remoter areas, considerable tracts of forest are unmapped, unsurveyed, and without established titles. Recognition of titles in the forest is a corollary of growing consciousness, public and private, of the extent and value of these resources; it is often a precursor of, and usually a prerequisite for, extended forest administration." There is some evidence to show that in these less developed regions — particularly in countries which have recently achieved independence — as determination of titles proceeds there is an increasing disposition to establish public titles to forest land. This evidence is derived from a scrutiny of individual returns. In any comparison of the aggregate tables for this and the preceding inventory, changes in ownership are overshadowed by the substantially greater areas of forest revealed by recent inventories in countries with planned economies, where public ownership is general.

Many countries provided information about the area of forest owned by industrial enterprises. Table 7 lists those countries where industrially-owned forests cover a substantial area (over 250,000 hectares) or represent a substantial proportion (over 25 percent) of all privately-owned forest.

Table 7. – Selected Data Relating to Forests Owned by Industrial Enterprises

Country	1,000 hectares	% of all private forests
Ivory Coast	300	100
Tanganyika	259	100
Guatemala	960	79
Colombia	2 800	74
Dominican Republic	423	70
Madagascar	550	55
Canada	4 699	39
Sweden	5 620	33
United States	25 246	17
Norway	716	12
Finland	1 644	11
Japan	794	6
Spain	450	3

Of the countries which reported this information, 34 were able to distinguish between forest owned by industrial enterprises operating wood-using plants and that owned by other industrial enterprises. Of the 14.5 million hectares so distinguished, 10.4 million hec-

TABLE 8. – COMPOSITION OF FORESTS-IN-USE[1]

Region	Coverage[2]	Total	Conifers	Nonconifers	Mixed woods[3]	Open areas[3]	% conifers[4]
	%	*Million hectares*					%
Europe	100	135	72	49	10	4	59
U.S.S.R.	100	459	(...362....	.....97....	.....	.....)	79
North America	100	400	188	102	70	40	55
Central America	78	14	(.....4....	.....10....	.....—....	.....—..)	29
South America	99	76	7	61	4	4	11
Africa	85	125	(.....2....	.....122....	.....1....	.....)	2
Asia	97	236	38	185	7	6	17
Pacific Area	99	20	(.....4....	.....15....	.....1....	.....)	22
TOTAL	98	1 465	677	641	93	54	54

[1] The figures in this table are world estimates. Separate figures for *reported data only* are not given, because they cover all but 31 million hectares of the forests-in-use.
[2] Area of forests-in-use for which composition data were reported, divided by total area of forests-in-use.
[3] Mixed woods and open areas are often included in the area of pure conifers and nonconifers. The total figures for pure stands are therefore overstated and those for mixed woods and open areas understated.
[4] Includes a reported allowance for conifers in mixed stands.

tares, or 72 percent, are owned by forest industries. Not surprisingly, it is in the countries where forest industries are highly developed that steps have been taken by industry to control its own wood supply. Some of the figures returned include, in fact, plantations established by industry. It will be interesting to see whether the next inventory confirms the general impression that there is a marked upward trend in this category of ownership, since this is bound to have an impact on the level of management. As is well known, many important forest industry enterprises today are setting a good example in management practice. It is much more difficult to ensure that sound principles of forestry are applied in the many millions of small private forest holdings, some information about which was presented in the report on the 1953 inventory, but extension work among farm forest owners is now regarded by many national forest authorities as one of their most important tasks.

Distribution of forest types

The composition of the world's exploited forests is summarized in Table 8. Taking account of the conifers included in the mixed forests, more than half the forest area exploited today consists of coniferous species. These are largely concentrated in the cool temperature zones of the northern hemisphere, so that the U.S.S.R., North America and Europe account for 92 percent of all coniferous forest under exploitation.

The exploited broadleaved stands are more evenly distributed, though it is striking that the three aforementioned regions, where the broadleaved stands consist almost entirely of temperate hardwoods, account for as much as 300 million hectares, or 42 percent, of all hardwood stands exploited. Of the vast areas of tropical broadleaved forest in Central and South America, Africa and Asia (over 2,000 million hectares according to an estimate given later in this report) only one sixth are regularly yielding timber or other forest products.

The data reported do not make possible an assessment of the area of forest under bamboo, a forest product which plays an important role in many Asian and some Latin-American countries. Some particulars are given in the published report, but these clearly relate in most cases only to those bamboo stands which can readily be distinguished and do not include the considerable areas within the forest where bamboo has taken possession following exploitation and shifting cultivation.

Table 8 gives a fairly complete picture of the composition of the exploited forests. The composition of the total world forest area (including accessible forests not yet exploited and forests still inaccessible) is very different. In Table A (to be found on page 137 of the text of this report) an attempt has been made to estimate the composition of all the world forest area. It shows that 46 percent of the world's coniferous stands have been brought into use, but only 26 percent of the broadleaved forest, tropical and temperate, is as yet under exploitation. Whereas coniferous forests represent 37 percent of all the world's forests, they account for 52 percent of the forests which have so far been brought under exploitation.

The reasons why the coniferous forests have so far been brought more effectively into use are well known and need not be repeated here. It is perhaps worth while, however, to stress once again the danger of attaching too much importance to forest area and failing to take into account sufficiently the quality of the forests. This will become clear later in this report, when data concerning growing stock and density of tree cover are discussed.

Forest management

The progress made in prescribing areas to be maintained permanently under forest, the extent to which forest areas are managed with working plans, and the quality of cutting practices reported, all afford important indications of certain aspects of forest management.

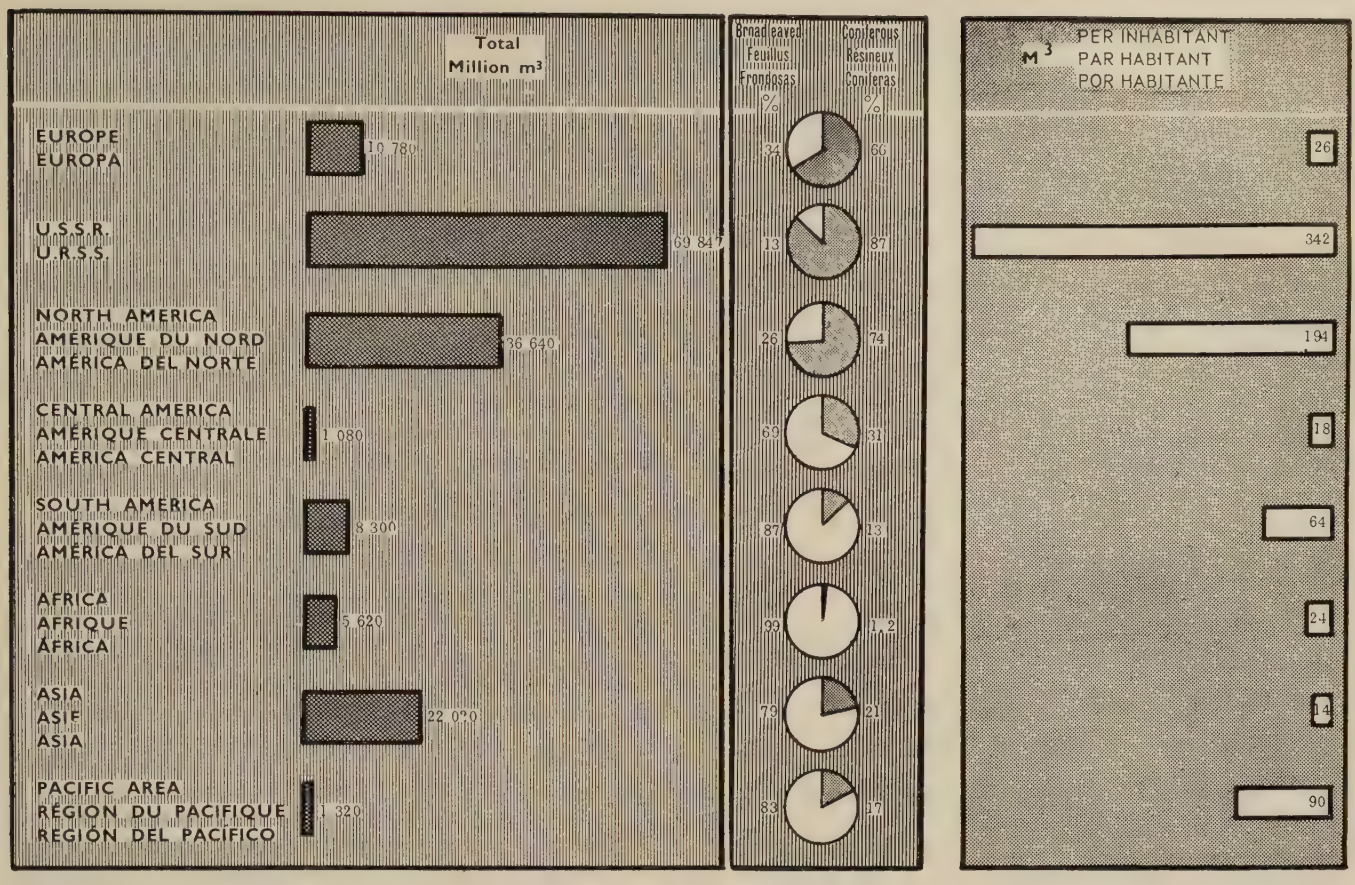


FIGURE 2. – *Growing stock in forests-in-use.*

The designation of land which it is intended to maintain permanently as forest is an important first step towards rational management of the forest. It constitutes a recognition of the need for a permanent forest area, it may involve a careful assessment of future forest needs, for productive and protective purposes, and it indicates the area within which management efforts will be concentrated. A number of countries reported in 1958 that failed to report in 1953, and several countries reporting in both inquiries were able to record substantial progress. If it is assumed, as would seem reasonable, that certain countries which reported in 1953 and failed to do so in 1958 had no change to report, the data summarized in Table 9 afford a clear indication of considerable progress made during the quinquennium.

Each region has some progress to report, even Africa, where the area reserved would seem to have diminished. This diminution is purely a statistical one, arising from the revised definition of forested land: it has excluded from the 1958 figures considerable areas of savanna land where the density of tree cover was less than 0.05. The fact of progress becomes clearer if for the several regions only those countries which specifically reported *changes* between 1953 and 1958 are listed.

TABLE 9. – PERMANENT FORESTS

Region	1953		1958	
	Countries reporting	Total area	Countries reporting	Total area
		1,000 hectares		*1,000 hectares*
Europe	27	123 290	27	124 030
Central America	11	690	13	4 325
South America	5	540	9	151 970
Africa	16	80 750	31	54 320
Asia	20	84 560	25	122 240
Pacific Area	6	7 810	7	8 610
TOTAL	85	297 640	112	465 495

TABLE 10. – CHANGES IN AREA OF PERMANENT FORESTS IN SELECTED COUNTRIES BETWEEN 1953 AND 1958

Region	Countries reporting changes	Permanent forests		
		1953	1958	Increase in area
		..... *1,000 hectares*		
Europe	10	13 119	13 877	758
Central America	2	147	1 906	1 759
South America	1	140	3 496	3 356
Africa	8	9 874	25 027	15 153
Asia	11	30 131	40 080	9 949
Pacific Area	3	7 378	8 173	795
TOTAL	35	60 789	92 559	31 770

This selection also omits those countries where the revised definition of forested land has had a serious impact on the statistics. The figures are thus strictly comparable and afford evidence of a gratifying increase in the area designated as permanent forest.

Considerable progress has also been made in establishing working plans, though the somewhat different coverage of the returns under this heading in the 1953 and 1958 inventories requires caution in drawing comparisons. Information is summarized for the two inventories in Table 11.

Coverage on this question has improved in Europe, and there would appear to have been a distinct increase in the area managed with working plans. There has been a slight increase also in North America (the figures here relate only to Canada); the sharp fall in the percentage area under plans arises, it should be noted, from a revised interpretation of forests-in-use. Little or no change is recorded in South America, Africa and the Pacific Area, but a very substantial advance in Asia, where the area under working plans has been notably extended in Burma, India, Japan and Thailand. For the first time, information is available for the U.S.S.R., where close on half of the 636 million hectares of national forests (*Goslesfond*) are managed with working plans.

Table 12 affords an interesting summary of how national forest authorities viewed prevailing cutting practices in their countries in 1953 and 1958. Inevitably these are figures which will not bear comparison from country to country, between regions, or even over time, since views as to what constitutes good cutting practice are evidently a matter of opinion. Even so, an " opinion poll " on such an important subject is not without interest. Coverage is roughly the same in both inventories, and it is evident (unless national standards have undergone important changes in the intervening years) that, in the view of those submitting the reports, no significant improvement has been effected. A reasonably high proportion of good cutting practices are held to

Table 11. – Management Status in Forests-in-Use

Region	1953 inventory				1958 inventory			
	Coverage [1]	Managed with working plans		Other	Coverage [1]	Managed with working plans		Other
	%	*Million hectares*	%	*Million hectares*	%	*Million hectares*	%	*Million hectares*
Europe	76	41	42	58	97	66	50	65
U.S.S.R. [2]	..	..	..	..	100	312	49	324
North America	30	36	54	31	47	40	22	146
Central America	99	5	26	13	76	2	17	9
South America		2	3	63	97	3	4	71
Africa	87	12	13	82	78	16	16	81
Asia	90	52	25	157	81	100	49	104
Pacific Area	94	9	54	7	97	9	47	10
Total	50	157	27	411	80	548	40	810

[1] Area of forests-in-use for which data concerning management status were reported, divided by total area of forests-in-use.
[2] Area of national forest fund (*Goslesfond*).

Table 12. – Cutting Practices in Forests-in-Use

Region	1953 inventory				1958 inventory			
	Coverage [1]	Good	Fair	Poor	Coverage [1]	Good	Fair	Poor
	Percentage				*Percentage*			
Europe	76	60	35	5	95	60	35	5
North America	..	..	..	...	53	65	25	10
Central America	99	4	41	55	75	10	20	70
South America		8	33	59	89	10	20	70
Africa	87	10	30	60	75	15	35	50
Asia	90	25	50	25	82	30	55	15
Pacific Area	94	60	15	25	96	60	15	25
Total	50	25	35	40	49	40	35	25

[1] Area of forests-in-use for which data concerning cutting practices were reported, divided by total area of forests-in-use.

prevail in Europe, North America (in this case the figure relates to the United States only) and the Pacific Area. Elsewhere good cutting practices are deemed the exception rather than the rule. Those authorities which report a high prevalence of poor or destructive cutting practices have clearly concern for the future of the forest crop.

It is perhaps significant that although the forest land area under working plans has increased in the past quinquennium, the quality of cutting in many countries has changed very little, although some overall improvement is recorded. Of the countries which were able to report an increase in the area under working plans, relatively few were able to report an improvement in cutting practices. Any conclusions drawn from these indications must, of course, be subject to the reservation that criteria for judging the quality of cutting may have changed and that the statistics of the area under working plans may have improved. Nevertheless, foresters will undoubtedly agree that much remains to be done in improving the management of the forests in all regions. For this improvement a necessary first step may be the drawing up of working plans, but even more important is the practical application of the measures outlined in the plan, the practice of forestry on the ground. The high prevalence of cutting practices deemed poor and destructive is a measure of the task confronting foresters.

Many more countries — 95 in all, representing 37 percent of the total area of exploited forests — have reported on the silvicultural system in force. Of the total forest area reported, coppice occupies 7 percent, and is particularly important in Southern Europe, Central America and Africa. Coppice with standards comprises 5 percent, and the remainder — 88 percent — high forest. Coppice yields mainly fuelwood and wood for charcoal burning, but can also provide poles, posts, fencing material and the like, as well as tanning bark and fodder. Coppice with standards also yields a low percentage of industrial wood, though it has naturally a proportion of larger-dimensioned material. The highest yield of industrial wood, however, comes from the high forest, and this accounts for the widespread, though by no means universal, trend towards the gradual conversion of coppice to high forest. Not universal, because there are conditions where coppice is the most appropriate system, by virtue of the assortments it yields and the foliage fodder it provides.

The process of conversion is, of course, a slow one, and a comparison of the reported figures with those of the earlier inventory does not allow of any general conclusions, since statistical improvements have largely obscured the slow changes which are taking place. These are evidenced, however, in the data for one or two European countries which have maintained accurate statistics of forest under different silvicultural systems for many years.

Growing stock in forests-in-use

The five years which have passed since the last world forest inventory have undoubtedly seen more activity in assessing the contents of the forest than any previous quinquennium. Up to 1953, in many of the advanced countries, the first postwar national inventories were only just getting into their stride. Since then substantial progress has been made, and most countries in Europe are now able to make a fairly reliable estimate of their growing stock. The same is true for North America and the U.S.S.R. Over the same period, many of the countries in Asia, Africa and Latin America have been able, often using modern inventory methods and obtaining technical guidance from overseas, to ascertain with more precision the growing stock on at least part of their exploited forest, thus widening and improving the basis for estimates of growing stock in all forests-in-use. The new information which has come to light during this period has brought with it some drastic revisions of earlier estimates. How drastic may be seen from the comparative figures set out in Table 13.

TABLE 13. – GROWING STOCK PER HECTARE IN FORESTS-IN-USE

Region	1953				1958			
	Coverage [1]	Total	Conifers	Nonconifers	Coverage [1]	Total	Conifers	Nonconifers
	%	..... m^3 *with bark*			%	..... m^3 *with bark*		
Europe	80	75	80	70	96	80	90	70
U.S.S.R.	100	95	100	65	100	152	168	91
North America	100	70	80	55	100	100	135	60
Central America	33	130	145	120	24	85	65	100
South America		120	270	115	20	125	170	120
Africa	74	75	40	75	71	25	45	20
Asia	91	100	90	105	96	90	110	90
Pacific Area	95	55	75	55	97	65	50	70
WORLD AVERAGES	..	85	95	75	92	110	145	70

[1] Area of forests-in-use for which data concerning growing stock were reported, divided by total area of forests-in-use.

TABLE 14. – GROWING STOCK IN FORESTS-IN-USE

Region	Reported data				Estimated totals					
	Coverage[1]	Total	Conifers	Non-conifers	Total	Conifers	Non-conifers	Total	Conifers	Non-conifers
	%	*Million m³ with bark*						*m³ per hectare*		
Europe	96	10 330	6 950	3 380	10 780	7 120	3 660	80	90	65
U.S.S.R.	100	69 847	61 043	8 804	69 847	61 043	8 804	152	168	91
North America	100	36 640	27 140	9 500	36 640	27 140	9 500	100	135	60
Central America	24	330	110	220	1 080	330	750	80	85	80
South America	20	1 560	160	1 400	8 300	1 060	7 240	115	135	110
Africa	71	2 080	50	2 030	5 620	70	5 550	45	30	45
Asia	96	21 210	4 470	16 740	22 020	4 620	17 400	100	120	95
Pacific Area	97	1 290	220	1 070	1 320	220	1 100	65	50	70
TOTAL	92	143 290	100 140	43 150	155 610	101 600	54 010	110	145	80

[1] Area of forests-in-use for which data concerning growing stock were reported, divided by total area of forests-in-use.

From this Table (which includes reported figures only) it will be seen that coverage has improved in Europe and that the most recent information available indicates a rather higher growing stock per hectare, for conifers and in total, than was reported in 1953. The data for the U.S.S.R. (which relate, actually, to the State Forest Fund — *Goslesfond* — and thus do not cover all exploited forests) incorporate the results of the national forest inventory which has been proceeding rapidly in recent years. In North America earlier estimates of growing stock have been revised sharply upward; the figures for Canada relate to accessible productive forests and those for the United States to all productive forests. For Latin America the figures show no substantial change, though it will be noted that coverage is low in both years. Africa shows the most drastic change, and this calls for some explanation. First, it will be noted that coverage has fallen somewhat; this stems from the rejection of some earlier figures which have proved, on closer investigation, to be excessively optimistic. Secondly, a number of countries which previously made estimates of total growing stock (all species) on the basis of rather tenuous data, have now submitted rather more precise data covering commercial species only. It is in this region, in fact, that the exclusions from the growing stock estimates (noncommercial species, trees below a certain diameter) loom largest, and the information available is unfortunately insufficient to allow of any grossing up to a total (all species, all diameters) basis. This very important reservation — which also applies, though with less weight, to Asia and Latin America also — should be kept firmly in mind in interpreting the summary tables which follow. In Asia, where coverage was high in both years, new data have raised the earlier estimate for conifers; the lower figure for nonconifers is largely due to classification changes, notably the exclusion of noncommercial species from the estimates for Thailand.

If the reported data on growing stock are taken as a starting point, and such assumptions as seem reasonable are made about the growing stock per hectare in non-reporting countries, it is possible to build up a tentative picture of growing stock in all the world's exploited forests. This is done in Table 14.

Total growing stock in all the world's exploited forests is thus now estimated in cubic meters at 156 million, as against 101 million estimated on the basis of the results of the last world inventory. This tentative estimate, it will be remembered, excludes — for very many countries — trees below certain diameters and species deemed without present commercial value. The increase as compared with the last inventory is partly due to changes in classification which have led to the reporting of greater areas of forest as "in-use," partly to a definite extension of the area of forest under exploitation, and partly to higher estimates of standing timber per hectare flowing from the most recent inventory information.

It will be recalled that in 1958, for the first time, countries were asked to report on the density of tree cover in their exploited forests. It was believed that this question might throw much needed light on the character of the forests presently taken into exploitation in the different regions of the world. The response to this question was far from complete, but the following table, summarizing the data reported, affords some interesting new indications:

TABLE 15. – ESTIMATED DENSITY IN FORESTS-IN-USE

Region	Coverage[1]	Good	Medium	Poor	None
	Percentage				
Europe	86	47	36	13	4
Central America	24	47	29	18	6
South America	16	51	33	15	1
Africa	54	17	39	36	8
Asia	28	32	48	16	4
Pacific Area	6	22	49	29	—

[1] Area of forests-in-use for which data concerning density were reported, divided by total area of forests-in-use.

These figures should not, of course, be interpreted without discrimination. A low tree cover may reflect a temporary phase in the evolution of a forest adequately stocked. Such areas, however, represent a fairly small proportion of the total area of forests-in-use reported on under this heading. The Table reveals that in Europe, where response to this question has been good, there is a surprisingly high proportion of forest with poor or only fair tree cover, when it is borne in mind that it is in this region that management is most intense. In Africa, where data are available for over half the exploited forests, only one sixth of the forest area is regarded as having good tree cover. The data for other regions are too sparse to permit of generalizations; even so, the relatively high proportion of reported forests in all regions described as of poor or nil density points to the danger of assuming that all forests so far taken into exploitation are necessarily rich in content.

Do the data assembled in the inventory permit a rough assessment of the timber content of *all* the world's forests, including the accessible forests not yet under exploitation and the vast area of forest so far inaccessible? Evidently this is a very cavalier operation, but piecing together the various indications afforded by the inventory, and taking into account the views (reported later) of national forest authorities concerning the proportion of the still inaccessible areas which may prove to be productive, one can hazard the guess — it is no more than a guess — that the volume of growing timber in the world today is of the order of 320 thousand million cubic meters.

Growth and allowable cut in forests-in-use

The coverage of the reported data on gross increment shown in Table 16 is less than in the 1953 inventory in Europe, the Americas and Asia. Somewhat better returns were received from Africa and the Pacific Area.

Insufficient information on losses (fire, shifting cultivation, insect, fungus, etc.) was reported to allow meaningful estimates of net growth by regions. Such estimates as were reported indicate that the magnitude of these losses ranges from a low of about 3 percent of the gross increment in Europe to a high of about 48 percent in the Pacific Area.

The reported data, with such other information as was available, were used to estimate the regional and world gross increment shown in Table 16. These estimates are necessarily rough — when forestry authorities are reluctant to make estimates for a single country it obviously takes courage to make estimates for a whole region. Nevertheless, the gross increment figures were built up country by country and aggregated for the regions. The results reflect the changes countries have made in their growing stock estimates, which were discussed in a previous section, and also changes stemming from new data compiled in many countries, for example in the U.S.S.R. and the countries of North America.

A comparison of the present estimates with the figures in the 1953 inventory shows small increases in the volume of annual growth in Europe, the two Latin-American regions and the Pacific area. As a result of new forest appraisals, the growth estimates for the U.S.S.R. and North America are much higher. For Africa and Asia, however, the new estimates are lower, for two main reasons: many countries changed reports from an "all species" estimate to "commercial species only," and new information indicated in some countries that the former growth estimates were too optimistic.

The growth (gross) for the world's forests-in-use is now estimated to total about 2,800 million cubic meters compared with the 1953 estimate of 2,390 million. Of this volume 51 percent is in the coniferous species; in 1953 the coniferous percentage reported was 45. The change results mainly from the higher growth figures

TABLE 16. – GROWTH IN FORESTS-IN-USE

Region	Reported data						Estimated totals					
	Coverage [1]	Gross increment			Losses	Net growth	Gross increment					
		Total	Conifers	Non-conifers			Total	Conifers	Non-conifers	Total	Conifers	Non-conifers
	%	*Million m³ with bark*					*Million m³ with bark*			*m³ per hectare with bark*		
Europe	90	302	196	106	11	291	330	210	120	2.5	2.7	2.3
U.S.S.R.	..	854	690	..	..	..	854	690	164	1.9	1.9	1.7
North America	53	577	296	281	113	464	820	470	350	2.3	2.4	2.2
Central America	11	3.8	1.4	2.4	0.9	2.9	35	10	25	2.7	3.1	2.5
South America	5	3.6	0.1	3.5	—	3.5	195	25	170	2.7	3.3	2.6
Africa	37	37	5	32	18	19	105	5	100	0.8	2.3	0.8
Asia	56	183	74	109	22	161	429	9	420	2.6	2.4	2.6
Pacific Area	90	30	3	27	14	16	35	9	27	1.7	2.0	1.7
TOTAL							2 799	1 428	1 371	2.1	2.2	2.0

[1] Area of forests-in-use for which data for gross increment, losses and net growth were reported, divided by total area of forest-in-use.

reported for the U.S.S.R. and North America. These two regions account for 60 percent of the annual gross increment of all the world's forests-in-use, 81 percent of the annual volume increase in conifers and 37 percent of that in non-conifers. Changes in gross growth figures arise partly from changes in forest area (already discussed) and partly from revised estimates of growth per hectare.

When calculated on a per hectare basis, the gross increment estimates show a rise in the U.S.S.R. and North America for both conifers and nonconifers, for reasons already mentioned. New data from Africa have influenced the regional estimates upward for conifers, reflecting the favorable growth rates found in many plantations of exotic species, but a drastic decrease has been indicated for the nonconifers. This is partly a result of the change in reporting whereby certain non-marketable species and sizes are left out of the estimates. Many countries also have found that the growth in virgin or newly-cut stands is considerably less than the theoretical volume.

Very favorable per hectare growth figures are reported for both Central and South America. It will be interesting to see whether these figures are confirmed by the new inventories and forest resource appraisals being initiated or in progress in several of the Latin-American countries. The average growth in cubic meters per hectare for the world is estimated at 2.2 for conifers, 2.0 for nonconifers and 2.1 for all species; in the 1953 inventory the figures were 1.8, 2.5 and 2.1, respectively.

An appreciable part of the losses included in Table 16 are a result of the practice of shifting cultivation. In the tropical regions — Asia, Africa, Central and South America — many of the forest lands cannot be considered as dependable sources of industrial products until this practice has been eliminated or controlled. Most countries subject to the waste of shifting cultivation cannot give more than rough estimates of the wood volume destroyed annually, but an average from 14 reporting countries indicates that it amounts to about 17 percent of the gross increment. The figures for a few selected countries are shown in Table 17.

Table 17. – Losses from Shifting Cultivation in Selected Countries

Country	Million m^3	% of gross increment
Philippines	5 826	40
Viet-Nam, South	800	31
Senegal	1 300	17
Sudan	354	12
Madagascar	240	5

The concept of *allowable cut* is used in many countries to guide the fellings that may be planned or authorized over a period of time. Many countries in the tropical regions, however, report that their fellings are controlled on other bases, for example by cutting areas or girth limits. It is believed, also, from the reports received that in many instances an allowable cut figure has been set, near or equal to the estimated net growth,as a matter of principle rather than as the expression of a policy which is being effectively implemented. In other words, there would seem to be a number of forest authorities that recognize the desirability of adjusting fellings to growth, even though the related data they report — e.g., on management status — suggest that the means at their disposal for doing so are inadequate.

Two of the largest forested countries, the U.S.S.R. and the United States, do not report allowable cut. Most of the countries of Europe, on the other hand, attach considerable importance to the allowable cut concept. Their management plans for individual forest tracts contain estimates of allowable cut and the figures can be aggregated to derive allowable cut estimates for the countries. In these countries the production of the forests (net growth) and the policy decisions on harvesting (allowable cut) are correlated in the working plans, and the volume of fellings gives some indication of how well the plans are being carried out. These figures are shown for Europe in Table 18.

Table 18. – Net Growth, Allowable Cut and Fellings in Forests-in-Use in Europe

Coverage [1]	Total			Per hectare	
	Net growth	Allowable cut	Fellings	Net growth	Allowable cut
%	..... *Million m^3 with bark*			.... *m^3 with bark*	
93	309	276	282	2.5	2.2

[1] Area of forests-in-use for which data for net growth, allowable cut and fellings were reported, divided by total area of forests-in-use.

Fellings will deviate from allowable cut for particular years because of fluctuations influenced by market conditions, extraction difficulties arising from adverse climate, etc. For a number of European countries the allowable cut is set by national forest policy at a figure lower than the net growth in order to build up the growing stock to more desirable levels. In a few countries, a different situation exists, the allowable cut figure exceeds net growth, perhaps to allow for conversion of over-mature stands to more productive young stands.

During the course of the past few years, FAO has compiled information on medium-term forecasts of forest removals in Europe. For 20 countries for which full information is available, the 1958 removals (which are less than fellings by the amount of logging and transport losses) exceed the allowable cut by 16 percent. At the same time the allowable cut for these countries has been set at 9 percent below net growth. The forecasts show that removals in the year 1965 will still exceed the 1958 net growth by 4 percent. Thus, in certain European countries, market needs and other considerations have so far overruled the objectives set out by the forestry authorities in the management plans, or

Table 19. – Removals from the World's Forest
Annual average [1]

Region	Total		Industrial wood		Total		Industrial wood		Fuelwood	
	1950-52	1955-57	1950-52	1955-57	1950-52	1955-57	1950-52	1955-57	1950-52	1955-57
	Million m³ without bark				*m³ per 1,000 inhabitants*					
Europe	288	301	175	198	729	733	444	482	285	251
U.S.S.R.	285	346	177	224	1 549	1 728	962	1 119	587	609
North America	378	408	312	348	2 242	2 211	1 850	1 886	392	325
Central America	34	36	5	6	650	605	96	101	554	504
South America	153	155	20	23	1 349	1 221	176	181	1 173	1 040
Africa	96	118	8	10	465	516	39	44	426	472
Asia	220	266	55	95	158	175	40	63	118	112
Pacific Area	18	21	11	14	1 355	1 403	828	935	527	468
World	1 472	1 651	763	918	583	602	302	334	281	268

[1] Includes removals from forests-in-use, other forests, from trees outside the forests, and includes estimates for nonreporting countries.

— and this is known to be true in one or two cases — there is tacit recognition of the fact that allowable cut has been set at a conservatively low figure.

Fellings and removals

Complete felling figures are available from relatively few countries. Removals volumes are, however, published annually in the FAO *Yearbook of Forest Products Statistics* and cover nearly all the countries of the world.

The difference between the removals and the volume of timber actually felled, which constitutes the amount of losses in logging and transportation, ranges from a low of less than 10 percent as an average for the countries of Europe to as much as 25 to 35 percent for some countries of Latin America and Asia.

The removals volumes shown in Table 19 include not only the recorded removals from forests-in-use, but also such information as is available on unrecorded volumes, removals from trees outside the forests and removals from forests classified as other than "in-use." The latter two types of removals will be discussed in more detail in the section on "other roundwood supplies."

World removals of roundwood have in fact risen considerably since the time of the last inventory.[2]

World removals have risen by 179 million cubic meters or 12 percent. A bigger proportion of the world's timber output is being used industrially, 56 percent as against 52 percent in 1950-52. It should be noted, however, that statistics for fuelwood are understated in many regions because of the large unrecorded amounts used by local inhabitants. There are grounds for believing that the amounts — very substantial — escaping record are diminishing, so that the fall in fuelwood removals per 1,000 inhabitants, from 281 to 268 cubic meters shown in Table 19 almost certainly reflects a real decrease in consumption.

Industrial wood removals have not only risen in total; they have risen also on a cubic meters *per caput* basis, from 583 per 1,000 inhabitants to 602, or by 3 percent. The increase is most marked for the U.S.S.R. (12 percent).

Other roundwood supplies

A significant proportion of the roundwood removals discussed in the preceding section is derived from sources other than forests under active commercial exploitation. The most important "outside" sources for both industrial wood and fuelwood are trees planted along roads, railways and canals, trees in parks and gardens, trees in windbreaks, brushlands and agricultural zones, the timber of which is collectively termed "trees outside the forests." According to 1958 figures reported to FAO, 37 countries have removals from trees outside the forests with volumes ranging up to 99 percent of total removals in Tanganyika. The figures for some selected countries are shown in Table 20.

Table 20. – Removals from Trees Outside the Forests in Selected Countries, 1958

Country	1,000 m³	% of total removals
Tanganyika	20 503	99
Southern Rhodesia	2 999	95
Tunisia	673	76
Italy	9 902	49
Ceylon	125	39

The proportion of industrial wood in the removals from trees outside the forests in 1958 was 6 percent. It is safe to say that the volume of wood harvested

[2] The comparison in the table and the paragraph which follows is actually with data taken from *World Forest Products Statistics, A Ten Year Summary, 1946-1955*, which includes more comprehensive figures than were included in the 1953 Inventory report.

from this source is not fully known and deserves further study by forestry authorities in countries where better knowledge of present raw material sources and potential future supplies is needed.

In order to avoid overlooking any important source of roundwood removals the 1958 inventory requested data on volumes derived from forests other than those classified as "in-use." As was expected, removals from such areas are very small, on a worldwide basis slightly over 1 percent of the reported global volume.

The volume of removals from unrecorded sources, from trees outside the forests and from forests classified as other than "in-use" constitute important elements in the supply of both industrial wood and fuelwood in many countries.

Changes in forest resources

The afforestation accomplishments of 70 countries are reported in the present inventory; 83 countries reported in 1953. The total area reported as afforested was considerably greater, however, with over 3.95 million hectares planted during the five years 1953-57, as compared with 2.65 million planted during the *six*-year period 1947-52. There is reason to believe that the reports are not complete even though in some regions, for example in Europe, considerable progress in improving afforestation statistics has been made in recent years. Areas afforested privately, without any form of state aid, still escape record in many countries. The regional figures are given in Table 21.

Table 21. – Afforested Areas Between 1953 and 1957

Region	Number of countries	1,000 hectares
Europe	20	1 831
Central America	2	5
South America	3	159
Africa	25	634
Asia	16	1 255
Pacific Area	4	67
Total	70	3 951

The areas planned for afforestation for the 1953-57 period and reported in the 1953 inventory were exceeded by a number of countries, for example, some noteworthy achievements were recorded in the following (planned areas in parentheses): Denmark 6,000 hectares (3,200), Western Germany 40,000 (20,000), Ireland 33,000 (24,000), Norway 53,000 (31,000), Portugal 138,000 (40,000), Madagascar 50,000 (9,000), Ruanda-Urundi 20,000 (10,000), Sierra Leone 30,000 (1,600), South Korea 492,000 (229,000), Taiwan 205,000 (75,000) and Australia 51,000 (41,000). The largest afforested areas were reported from Spain, Southern Korea, Poland, Belgian Congo, Japan and Taiwan.

The reporting countries expect to afforest 2,578,000 hectares during the quinquennium ending in 1962, a reduction of 35 percent from the area afforested during the previous five-year period.

Some diminutions in forest area have offset the favorable record in afforestation. The largest reduction was reported from the Philippines, where much forest land was reclassified as agricultural land. Other countries reporting large reductions were Senegal, Ghana, Bulgaria, Sudan, Mauritania and Honduras.

With transportation systems steadily improving, more and more of the world's forests are coming within reach of exploitation. It has already been noted that the proportion of the forest area deemed accessible in 1958 is 62 percent, as against 47 percent in 1953. These figures, of course, considerably overstate the improvement which has occurred since, as has already been pointed out, the definition of accessibility has changed and statistics generally have improved. Providing these qualifications are borne in mind, however, the figures in Table 22, summarizing some of the more important reported changes, are of considerable interest.

Table 22. – Increase in Accessible Forests

Region	Number of countries	Areas which have become accessible 1953-57
		1,000 hectares
Asia	8	13 202
Africa	7	9 900
South America	1	1 800
Europe	5	722
Central America	2	213
Pacific Area	1	8

The next World Forest Inventory will no doubt show more clearly the impact of improving communications on forest accessibility.

Among the countries in which improvements in transportation during the next decade will open up large new forest areas are Ecuador, Sudan, Liberia, Burma, Honduras and Thailand.

As the forests become more accessible and as forest industries are developed, more and more areas will be exploited. In response to the inventory question on how much area was expected to be put into use during the decade ending in 1968, 29 countries reported, with the increase in exploited forests expected to total over 28 million hectares. The increases in selected countries are shown in Table 23.

Changes in forest area from productive to unproductive from causes such as misure of land and vegetative cover, from accelerated erosion, flooding for hydroelectric developments, etc., were reported by only 12 countries and involved 850,000 hectares. Cases of deterioration in the productivity of forest lands occur in all parts of the world but statistics on the areas involved are often not available.

Table 23. – Increase in Forests-in-Use in Selected Countries

Country	Expected increase by 1968	
	1,000 hectares	*% of forests-in-use*
Federation of Malaya	777	353
Ecuador	1 000	333
New Guinea (Austr.) and Papua	405	162
Spanish Guinea	350	146
Sudan	2 300	70
Gabon	5 000	50
Ghana	791	46
Guatemala	1 040	39
Belgian Congo	2 200	36
Viet-Nam, South	1 000	27
Brazil	10 000	25
Japan	1 418	11

One of the objectives of national inventories of forest resources is to determine the area of forests which are likely to be sources of industrial raw materials. The forest resource base thus includes not only the forests-in-use and accessible productive forests but also the productive forests that are still inaccessible. Information about the more remote forests, mostly inaccessible, are seldom compiled where forest inventories are at the beginning stages. Many countries are, however, assembling this information through inventories, extensive reconnaissance or other means. The replies from 47 countries as to the productive and unproductive area of their inaccessible forests are summarized by regions in Table 24.

Table 24. – Inaccessible Productive Forests

Region	Number of countries	Total	Productive	
		1,000 hectares		%
Europe	3	391	255	65
Central America	7	6 657	4 900	74
South America	3	35 215	21 160	60
Africa	17	120 923	78 718	65
Asia	15	50 167	32 189	64
Pacific Area	2	778	546	70

It is extremely encouraging to find that no less than 48 countries are able, no doubt on the basis of somewhat sketchy indications in some instances, to make a provisional assessment of the quality of the vast forest areas still beyond physical reach of exploitation. Many conflicting views have been expressed about the ultimate potential of these forests, how valuable they would prove to be when finally penetrated. The data presented in Table 24 show that the forest authorities concerned reckon that a substantial proportion, ranging from three fifths to threequarters, consists of productive forest, forest capable of producing usable crops of wood or other forest products.

The reported data are insufficient to allow of an estimate of regional totals; indeed, it is not known whether the situation in the reporting countries is representative of the general situation in the respective regions. But even the partial figures are striking. The 21 million hectares of inaccessible forest considered productive by the only 3 South American countries reporting, for example, represent an area equivalent to 28 percent of all forests in that region presently under exploitation. In Africa, the 79 million hectares of inaccessible forest reported as productive equals about two thirds of the area of forest presently in use throughout the region.

Conclusions

The report on the 1953 World Forest Inventory made it clear that the world's forests are theoretically capable of furnishing a plentiful flow of products for a world population much higher than that of today. This is confirmed by the new inventory, and in general the latest data suggest that some of the untapped resources of the world are perhaps richer than was at one time supposed. Furthermore, new national inventories have revealed a much higher volume of timber in North America and the U.S.S.R., and a somewhat higher volume in Europe, than earlier figures had suggested.

Of 4,405 million hectares of forested area, only 33 percent are being exploited 2,940 million hectares have not yet been brought into use, and of this area no less than 1,268 million hectares are presently deemed within physical reach of exploitation. The vast area of forest still lying beyond reach of exploitation includes substantial areas which are likely to remain unexploited within the foreseeable future, either because of their quality or their location. Even so, some 50 countries are able to report that well over half of their forests still inaccessible are considered productive in the sense that their composition is such as to warrant the hope that some day, if the need arises, they can economically furnish a flow of forest products. The forests are not, of course, evenly distributed over the earth's surface, and the apparent timber wealth in global terms must not be allowed to obscure the fact that some regions are very rich, others exceedingly poor, in forest, in relation to the populations they have to serve — whether that service is rendered primarily through the timber crop or whether it pertains to the ever-important, and often crucial, protective role of the forest. The inventory contains some indications of the area of land being lost to forest, sometimes through settlement for permanent agriculture, often as a result of the ravages of shifting cultivations. This last is a disturbing feature, not merely for the forest wealth so destroyed, nor even for the disastrous consequences that may ensue for the soil and water regime, but also for its social aspects. Countries in an early stage of development, intent on raising living standards — in both their cultural and material aspects — can ill afford to leave whole sections of their communities living in the neolithic stage. Obvi-

ously much more needs to be known about the extent, nature and impact of shifting cultivation. In a world on the move it is idle to claim that under certain forest and soil conditions this is the form of agriculture best adapted to the local environment. For while this judgment may be valid under special circumstances, it is a judgment based on purely technical considerations and one which fails to take into account human values and the need for human progress.

Such indications as are presented in this inventory concerning areas lost to forest, including shifting cultivation, make it clear that this whittling away of the forest area is not confined to those regions which are relatively well-endowed with forest.

On the other hand, the data assembled on afforestation do suggest that the last five years have witnessed the most energetic effort in history to extend the area of forest in those countries where forest cover is deemed inadequate for the forest effectively to play its productive and protective role. There is evidence, too, that many more countries are seriously considering what the future forest requirements of their populations are likely to be, and there is a gratifying increase in the areas of forest land which are being designated as permanent forest.

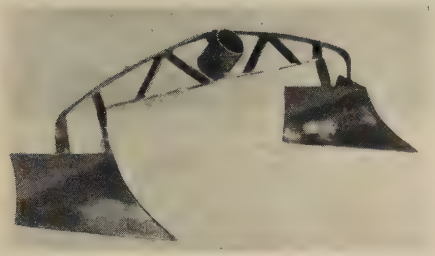
It is still the coniferous forests of the world, with their relative homogeneity, accessibility, and usable properties, which are being turned most effectively to account. The three regions of the northern hemisphere, Europe, the U.S.S.R. and North America, with 29 percent of the world's population and 46 percent of the world's forests, account for two thirds of all forests so far brought under exploitation and two thirds of all removals.

Five years ago it was estimated that gross increment in the coniferous forests-in-use was just about in balance with drain (fellings, losses from fire, insects, fungi, shifting cultivation, etc.). The additional resources revealed by this inventory, and to some extent the bringing of new areas in exploitation, suggest that the drain, at around 1,000 million cubic meters with bark, is still considerably less than growth, estimated at 1,400 million cubic meters. In the 709 million hectares of exploited broadleaved forest, gross increment may be reckoned at approximately 1,370 million cubic meters with bark, of which fellings and losses annually drain off perhaps 1,200 million. The very magnitude of natural losses and losses during logging and transportation in some regions show how much has yet to be achieved in forest protection and harvesting methods.

Considerable strides have been made in forest management during the quinquennium, though it is to be feared that some of the figures reported are somewhat over-optimistic and part of the progress reflected by the statistics illusory. There is internal evidence to show that the considerable extension of the area under working plans, for example, in many cases expresses a hope and an intention rather than a realization, in the sense that although working plans may have been prepared and filed, they are not always rigorously adhered to in the forest. There is little to show that cutting practices have substantially improved, taking the world as a whole, though here again the statistics may conceal a disposition on the part of many forest authorities to bring higher standards to bear in their judgment.

But with all the deficiencies in the information here assembled — and no attempt has been made to hide the fact that serious gaps exist, that data are seldom comparable from country to country and not always consistent over time — three facts still remain. First, the present inventory does present a more comprehensive picture of the world's forest resources than either of its predecessors. Secondly, there has been encouraging progress in the coverage and standard of forest statistics over the last five years. Thirdly, very much remains to be done in most countries before national forest statistics can be regarded as adequate either for the formulation of long-term forest policies or for the sound planning of forest industries.

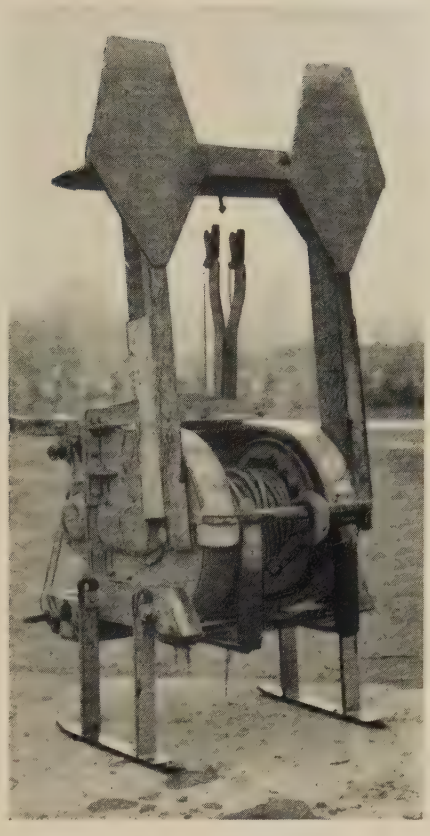
Equipment Section



Silvano Furrower. — Designed for use in nursery seeding or planting to open parallel furrows in loose, sandy and volcanic soils or in humus. Also serves for covering seeded furrows and for hoeing and weeding.

Weighs about 1.6 kg., consists of two blades joined by crosspiece. In standard model the 2 blades are spaced 50 cm. apart. In another model the spacing can be adjusted by screw bolt.

Attrezzi agricoli e forestali, Via Trento, Nicastro (Catanzaro), Italy.



Hesford Heavy Linkage Winch. — Carried on 3-point linkage of tractor and driven by shaft from tractor p.t.o. Winch stands on a frame which folds out of the way when the winch is on tractor. Drum diameter 6 in. (15.2 cm.), carries 150 ft. (45.7 m.) of 7/16 in. (11 mm.) diameter rope. Total weight of winch (with cable) 1,036 lb. (470 kg.).

C.M. Hesford and Co. Ltd., Ormskirk, Lancashire, England.

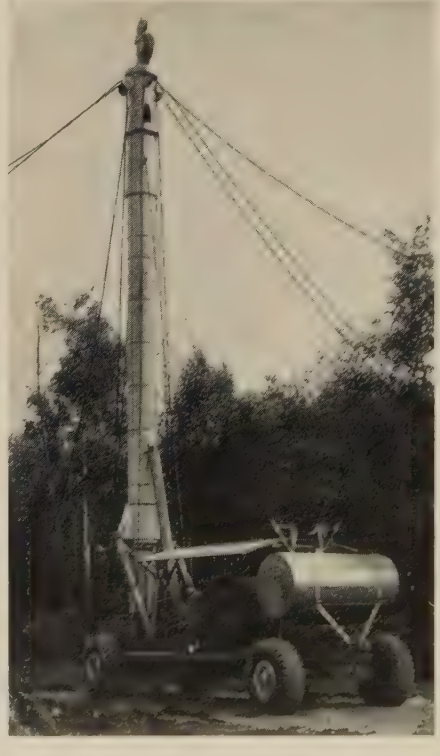
The Mechanical Development Committee, Forestry Commission, U.K., has made tests on performance. For additional information write to Mr. R.G. Shaw, Forestry Commission, 25, Savile Row, London W.1.

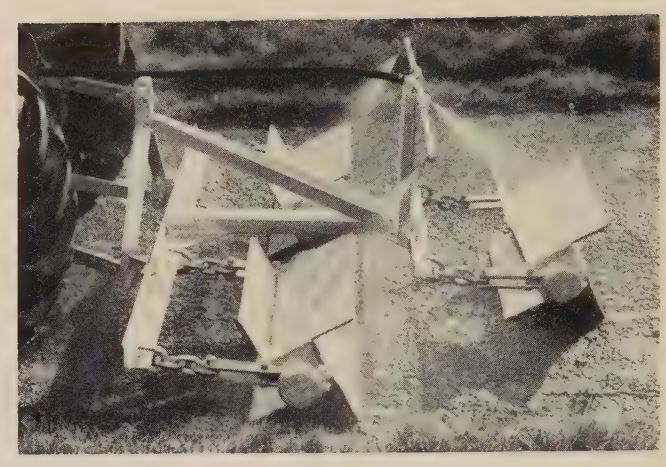
Becfab 15 in. (38 cm) Pump. — Drive by tractor or other prime mover. A transport carriage, easily detachable from the actual pump, can be supplied. All fittings, such as shaft, with universal points for connecting pump to tractor p.t.o. included as standard equipment. At a lift of 9 to 10 ft. (2.74 to 3.05 m.) output varies from 184,940 to 343,460 gals. (841,477 to 1,562,743 l.) per hour according to power available. No valves or strainers, small debris or other obstructions pass without damage. Construction consists of a sheet metal trunk, through the center of which is driving shaft on self-aligning ball bearings; at the bottom of 14 ft. (4.27 m.) trunking is a centrifugal type roto.

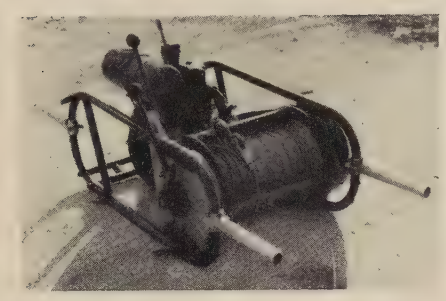
Becfabs (Engineers) Ltd., Newgate, Beccles, Suffolk, England.

The Sparmatic. Steel spar tree mounted on conventional vehicle, used in combination with yarder. Built as complete unit, one power source for both movement and operation. Employs hydraulic ram to erect tubular steel tree to vertical operating position and lower it to horizontal travelling position; once erected, spar telescopes out to normal operating height of 100 ft. (30.5 m.). 275 hp Cummins Diesel engine drives through Gearmatic transmission and torque converter to standard three-drum yarder. Drive for vehicle guyline winches and other functions taken from yarder gear train. Entire operation controlled from operator's position. Main line pull 0 to 100,000 lb. (45,359 kg.); weight: complete unit, all lines and fuel, 109,000 lb. (49,440 kg.).

Gearmatic Company Ltd., Newton, B.C. Canada.







Hathaway Portable Powered Winch. — Built into tubular frame with folding carrier handles. A Villiers 147 c.c. 4-stroke engine driven through centrifugal clutch by single chain to the winch drum. The winch cable is 100 yards (91.4 m.) long with a diameter of ¼ inch (6.4 mm.). A convenient method of ground anchorage is provided by four pins which pass through lugs on the frame. Field performance: maximum pull — with empty drum 1,100 lb. (499 kg.); with full drum 800 lb. (363 kg.). These pulls can be almost doubled by using a snatch block; winching speed (full torque) 88 ft. (26.8 m.) per min.; weight (gross with full tank) 192 lb. (87 kg.).

L. Hathaway Ltd., Oswestry, Shropshire, England.

The Hathaway winch is the result of development work by the Forestry Commission and L. Hathaway Ltd. For further information write to: Mr. R.G. Shaw, Forestry Commission, 25, Savile Row, London W.1.

Long Felling Tongs. — This tool permits not only hauling logs on the ground, but also pulling the tree after cutting, when it gets entangled in the branches of the standing trees.

Wm. Clark and Son., Agric. Engineers and Blacksmiths, Parkgate, Dumfries, Scotland.

The Cundey Loader. — Two side arms each mounted on a bolster on the lorry frame are let down to ground level and raised to vertical position by action of hydraulic rams housed in bolsters. Pump driven from p.t.o. on vehicle gearbox provides hydraulic power for operation of rams. Operator, by simple valve controls the loader. Length of arms adjustable for variations in ground conditions. Load can be lifted higher as load on lorry increases in height. Max. load with the arms fully extended is 10 cwt. (508 kg.). Ride or road width must be at least 20 ft. (6.10 m.). The total width occupied by the vehicle and side arms in the down position is 16 ft. (4.88 m.).

Mechanical Development Committee Forestry Commission, 25, Savile Row, London W.1.

Cundeys Ltd., Alfreston, Derbyshire, England.

Holt Spray Attachment for Holt Weed Breakers. — Spray attachment developed in connection with heavy-duty Holt weed breakers as used in the tropics and subtropics, to make possible the economical application of herbicides in dense growths.

Device consists of container tank mounted on tractor in which pressure is maintained by compressor fitted to tractor p.t.o. From jets of a rear-fitted boom, herbicide is directed onto blades of the weed or bracken breaker and, as these blades revolve, chemical is transferred onto the cut and lacerated stems of the weed growth.

The Holt Weed Breaker Company, Kirbymoorside, York, England.

Delmhorst Model G. 2. — Moisture detector permits reading of moisture content from 7 to 30 %. Not much larger than a camera 4 × 7 × 2 ½ in. (10 × 18 × 6.4 cm.). Weighs 2 ½ lb. (1.13 kg.). Constructed of aluminium and has adustable shoulder and neck strap for portability. Operated by battery; no outside power supply needed. Variety of interchangeable electrodes available to meet needs varying from those where thin veneers are checked for moisture content to those where checks are made on timber poles and ties.

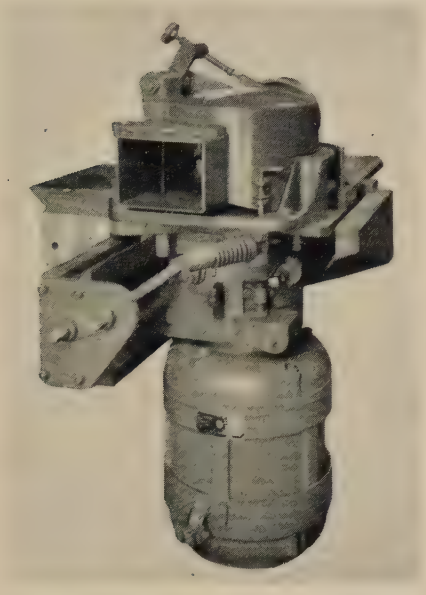
Delmhorst Instrument Co., Boonton, New Jersey, U.S.A.

Austin-Western Model 110 Hydraulic Crane. — Basic machine equipped with 2-wheel drive. General dimensions: wheelbase 9 ft. 7 in. (2.92 m.); overall length: boom horizontal 23 ft. 0 in. (7 m.); over-all height 8 ft. 10 in. (2.69 m.); over-all width 7 ft. 10 in. (2.39 m.); maximum boom reach (boom horizontal) 12 ft. 7 ½ in. (3.85 m.); maximum elevation 50°; maximum safe load off front of vehicle 10,000 lb. (4,536 kg.).

Austin-Western Construction Equipment Division, Aurora, Illinois, U.S.A.

Log Bronc. — Has steel hull, welded and braced to withstand extreme abuse from pushing and bumping logs in all water operations. Motor mount (turntable) provides for 360° turning. Short turns and changing direction possible without changing throttle setting or reversing engine drive. Propeller of outboard motor is guarded against logs and other debris by steel cage. *Specifications*: over-all length 13 ft. (3.96 m.); over-all width 5 ft. (1.52 m.); over-all draft 2 ft. (61 cm.); operating draft 2 ½ ft. (76 cm.). Weight 3,200 lb. (1,451 kg.) equipped with motor.

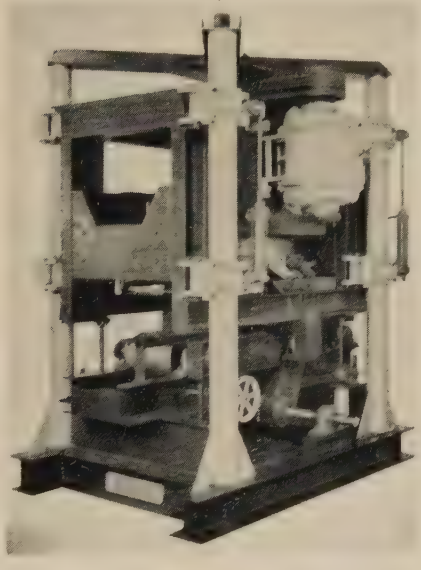
Nelson Log Bronc Co., P.O. Box 692, Coos Bay, Oregon, U.S.A.



Stetson-Ross Chip Blanker.
Chip Blanker removes excessive thickness and width of lumber in form of a chip, rather than as shavings. Chips suitable for use by pulp mills. Feed speeds of up to 1,000 lineal ft. (25.4 m.) per minute. Chippers operate at either 1,200 or 3,600 rpm. Cutterheads equipped with 2, 3, 5 or 6 knives depending on material worked and feed speeds. Can be supplied as single sidehead unit, a single tophead unit, or as combination unit with both topheads and sideheads. Use of frequency converter recommended, to control speed of cutterhead to correspond with feed speed of planing machine.

Chip blanker designed primarily for use with Stetson-Ross planers and matchers, but can be adapted to other makes of machines.

Stetson-Ross Machine Company Inc., 3200 First Avenue South, Seattle 4, Washington, U.S.A.



Sumner Planer Chipper. — Designed for planer mills, but may also be operated as independent chip producer or as part of the over-all planer operation. Consistently produces chips of uniform size and grade, readily acceptable to pulp mills. Standard machine designed to take stock with minimum sizes of 1 in. (2.5 cm.) thick by 2 in. (5 cm.) wide and a maximum of 4 in. (10 cm.) thick by 12 in. (30 cm.) wide. Greater dimensions can be achieved by special arrangements. Intended for handling lumber at speeds up to 1,000 ft. (305 m.) per minute.

Canadian Sumner Iron Works Limited, 3550 East Broadway, Vancouver 12, Canada.

Skyline Crane "Telegrue". — Can lift up and set down loads up to 2 tons along any point of skyline without stopping block. Operates by gravity, logging site must have 15-20 % slope. Special device adjusts skyline crane to gradient. Skyline may be 1,500 m. long. Main cable 24-28 mm. diameter. Manufacturer has 10-30 hp power winch mounted on skids, which pulls itself up steep slopes; equipped with air-cooled, diesel engine, 6-speed gearbox. Drum takes 2,000 m. of 11 mm. diameter cable, double hydraulic, disk handbrake, regulating air-brake and guide device. Can be disassembled into 100 kg. sections. Weight about 1,500 kg. max. pull 3,400 kg.

H.E. Weber, 65 Grande rue de la Croix Rouge, Grenoble, France.

FAO - WHAT IT IS - WHAT IT DOES - HOW IT WORKS: 1960

The Food and Agriculture Organization, a specialized agency of the United Nations, was set up in 1945 to help the people of the world in their continuing fight against hunger and malnutrition. The need for such an agency became clear during the second world war, which devastated agricultural production, transport and marketing systems. But it was also evident that a peaceful and healthy world could not be built upon the precarious prewar level of food supplies and their inadequate patterns of distribution.

Since then, the rising rate of growth of the world's population has added urgency to the need for international action to increase food supplies, to better their nutritional quality, and to make them accessible to the peoples of the earth. World population is now about 2,800 millions and is growing at the rate of more than 120,000 a day. It is expected to double by the end of the century. Food production has also been expanding, but on the whole it barely exceeds population growth. It has often not yet made good the setbacks of the war. In many places food supplies are only held at the inadequate prewar levels through greater food imports or smaller food exports, but even this is at the cost of foreign exchange badly needed for economic development.

However, the potential resources of the world are sufficient, under wise management, for greatly improving the food supply of even such a rapidly growing population. A great international effort is required to carry out this task of primary importance for the peace and well-being of the world, and it was for this purpose that FAO was created as a world-wide co-operative of governments (42 at the outset in 1945; 86 by January 1960). Each Member Government has one vote and pays a contribution proportional to its national income. These contributions provide the budget — US$ 18,980,000 for the biennium 1960-61 — to finance the regular activities of the Organization.

Member Governments review the world food and agricultural situation (including fisheries and forestry) by sending their delegations every two years to the Conference of FAO, the legislative body of the Organization. It is the Conference which plans the work of FAO and determines the level of the budget. It also elects the Director-General, who is the chief administrator, with authority over a Secretariat of some 1,300 international civil servants selected for their technical qualifications and drawn from all parts of the world.

Between sessions of the full Conference, the affairs of FAO are reviewed by a Council, which is composed of representatives of 25 governments. The three most important standing Committees of the Council are the Finance Committee, the Program Committee, and the Committee on Commodity Problems which reviews world trade in agricultural commodities.

FAO is not a supergovernment, but a " co-operative of governments ", and has no executive powers of its own. It is chiefly an advisory and consultative organization. It cannot, for example, produce food, or buy and distribute surplus stock, but it advises its Member Governments on policies and plans for food production and the disposal of food surpluses, and it provides them with technical assistance on request. It also informs the general public about food problems and enlists their support for the work which governments undertake through FAO for the solution of these problems.

FAO does three main kinds of work:

1. The initial step in tackling such an overwhelming problem as world hunger is to analyze and define it. FAO collects, analyzes and disseminates basic information such as statistical yearbooks on production and trade in agriculture, forestry and fisheries products, and prepares special studies on such diverse topics as soil conservation, animal disease control, farm mechanization, forest fire control, nutritional problems, and technical fisheries development problems. The Organization also convenes many international meetings for the study of specific aspects of food and agricultural problems. Governments are thus assisted in determining their policies and action programs for solving such problems.

2. Through its international technical staff, FAO provides, on request, direct technical advice and assistance to countries. For this purpose, FAO is allocated yearly a share of the United Nations Fund for Technical Assistance (in 1960 about US$ 8 million). FAO had completed upwards of 2,000 expert missions by 1960, and had awarded over 1,750 fellowships for the training of technicians. The establishment of the United Nations Special Fund in 1959 provided another means whereby FAO supplies assistance to governments in major projects at the pre-investment stage for the development of their resources.

3. FAO promotes co-operative action towards solving problems of food and agriculture. This is done in a number of countries in the same region, or among several countries which are facing the same problems. For instance, a co-operative program embracing a number of countries in the Near East has been set up to fight the desert locust. As another example, the FAO Committee on Commodity Problems brings Member Governments together to confer on such questions as the current world agricultural commodity situation problems of surplus or deficit in agricultural commodities, and measures to stabilize markets and prices. Similarly, FAO has established various study groups, committees, councils, commissions and other bodies to help promote and coordinate world food production. Such bodies include the International Rice Commission to raise production and consumption levels in rice-eating countries, and regional forestry and fisheries commissions and councils.

FAO Headquarters are in Rome, Italy. Its present Director-General is Binay Ranjan Sen of India. Under his authority, the Secretariat consists of a Technical Department, an Economics Department, and a Department of Public Relations and Legal Affairs, each under an Assistant Director-General, plus a Program and Budgetary Service and a Division of Administration and Finance. Within the Technical Department are Divisions for Land and Water Development, Plant Production and Protection, Animal Production and Health, Rural Institutions and Services, Fisheries, Forestry and Forest Products, and Nutrition; the Economics Department contains Divisions for Commodities, Statistics and Economic Analysis.

In order to assist governments more directly in the several parts of the world, FAO has Regional or Subregional Offices in Accra, Bangkok, Cairo, Mexico, Rio de Janeiro, Santiago and Washington. There is

an FAO representative in most of the individual countries receiving FAO technical assistance.

A Special Effort

Freedom from Hunger Campaign

In spite of fifteen years of national and international effort, progress towards the goals set out in FAO's charter has been slow and a world free from hunger is not yet in sight. Clearly, special efforts are called for if the vision and idealism behind the foundation of FAO are to yield the expected results.

It is in this context that B.R. Sen, FAO's Director-General, saw the need for a world-wide campaign against hunger and want. Under the title " Freedom from Hunger Campaign ", the Member Nations of FAO adopted the project at their Conference in November 1959. Although the inspiration for the Campaign has come from FAO, which will continue to offer leadership and guidance in regard to the various activities contemplated, the Campaign now belongs to the world. No single organization, national or international, can fulfil the purposes of the Campaign. Its success depends upon the enthusiastic co-operation and willing participation not only of governments, the United Nations and the Specialized Agencies, and international non-governmental organizations, but also of private foundations, religious bodies and men and women of goodwill everywhere. Broadly speaking, the activities of the Campaign will be twofold: first, the promotion of a climate of opinion throughout the world in which the problems of hunger and want will be discussed, their causes analyzed and their remedies sought. This is an activity which will be most appropriately taken up by the more developed and prosperous countries. The second category of activity will include national and regional research and action projects designed to accelerate the tempo of development in underdeveloped countries and to secure increased production of food and better standards of nutrition.

The Campaign is initiated in a spirit of rededication to the basic objectives for which FAO was created. It will extend from 1960 through 1965, highlighted by a World Food Congress in 1963.

FAO In Brief

History

1943: United Nations Conference on Food and Agriculture held at Hot Springs, Virginia, U.S.A., established Interim Commission to draft constitution.

1945: Delegates of 42 countries met at Quebec Canada, and founded the Food and Agriculture Organization of the United Nations.

1951: FAO, with 68 member nations moved to permanent Headquarters in Rome, Italy.

1960: Total of Member Nations 86.

Constitution

FAO is one of the autonomous specialized agencies of the United Nations. It has close working relationships with the United Nations through the Economic and Social Council, as well as with its sister specialized agencies.

Governing and other bodies

Conference. Meets normally every other year; elects Director-General, sets policy, determines program, funds and scale of contributions; each Member Nation has a single vote.

Council. 25 Member Nations elected by Conference for three-year terms under an independent chairman (also elected by Conference); acts as the interim governing body, meeting one to three times annually.

Committees. The most important standing committees of the Council are the Finance Committee, the Program Committee and, of particular interest, the Committee on Commodity Problems which consists of 24 Member Nations elected by the Conference.

Secretariat. About 1,300, of which 1,000 are stationed at Rome Headquarters and the remainder in Regional and Subregional Offices. The Director-General is elected by the Conference: the present Director-General, Binay Ranjan Sen (India), was elected in September 1956, and re-elected in 1959 for a further period of four years. Former Directors-General: John Boyd Orr (U.K.), Norris E. Dodd (U.S.A.), P.V. Cardon (U.S.A.).

Budget. Voted by Conference. In the first year it was about $4.5 million. For the biennium 1960/61 it is almost $19 million. The budget is derived from contributions from Member Governments, proportional to their national income.

FAO Member Nations

As at 1 January 1960

Afghanistan
Argentina
Australia
Austria
Belgium
Bolivia
Brazil
Burma
Cambodia
Canada
Ceylon
Chad *
Chile
Colombia
Costa Rica
Cuba
Cyprus *
Denmark
Dominican Republic
Ecuador
El Salvador
Ethiopia
Finland
France
Gabon *
Germany
Ghana
Greece
Guatemala
Guinea
Haiti
Honduras
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Japan
Jordan
Korea
Laos
Lebanon
Liberia
Libya
Luxembourg
Madagascar *
Malaya
Mexico
Morocco
Nepal
Netherlands
New Zealand
Nicaragua
Nigeria *
Norway
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Federation of Rhodesia and Nyasaland *
Saudi Arabia
Senegal *
Somalia *
Soudan *
Spain
Sudan
Sweden
Switzerland
Thailand
Tunisia
Turkey
Union of South Africa
United Arab Republic
United Kingdom
United States of America
Uruguay
Venezuela
Viet-Nam
Yemen
Yugoslavia

FAO Offices

Headquarters

Viale delle Terme di Caracalla
Rome, Italy

Africa

FAO Regional Office for Africa
P.O. Box 1628
Accra, Ghana

Asia and the Far East

FAO Regional Office for Asia and the Far East

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* Associate Member

Maliwan Mansion
Phra Atit Road
Bangkok, Thailand

FAO Office for the Western Zone, Asia and the Far East
21 Curzon Road
New Delhi 1
India

Latin America

FAO Regional Office for Latin America
Casilla 10095
Santiago, Chile

FAO Office for Eastern South America
Rua Jardim Botânico 1008
Rio de Janeiro, Brazil

FAO Office for Mexico, Central America and the Caribbean
Apartado Postal 10778
México I., D.F.

Near East

FAO Regional Office for the Near East
Box 2223
Cairo, Southern Region
United Arab Republic

North America

FAO Regional Office for North America
1325 C Street, S.W.
Washington 25, D.C., U.S.A.

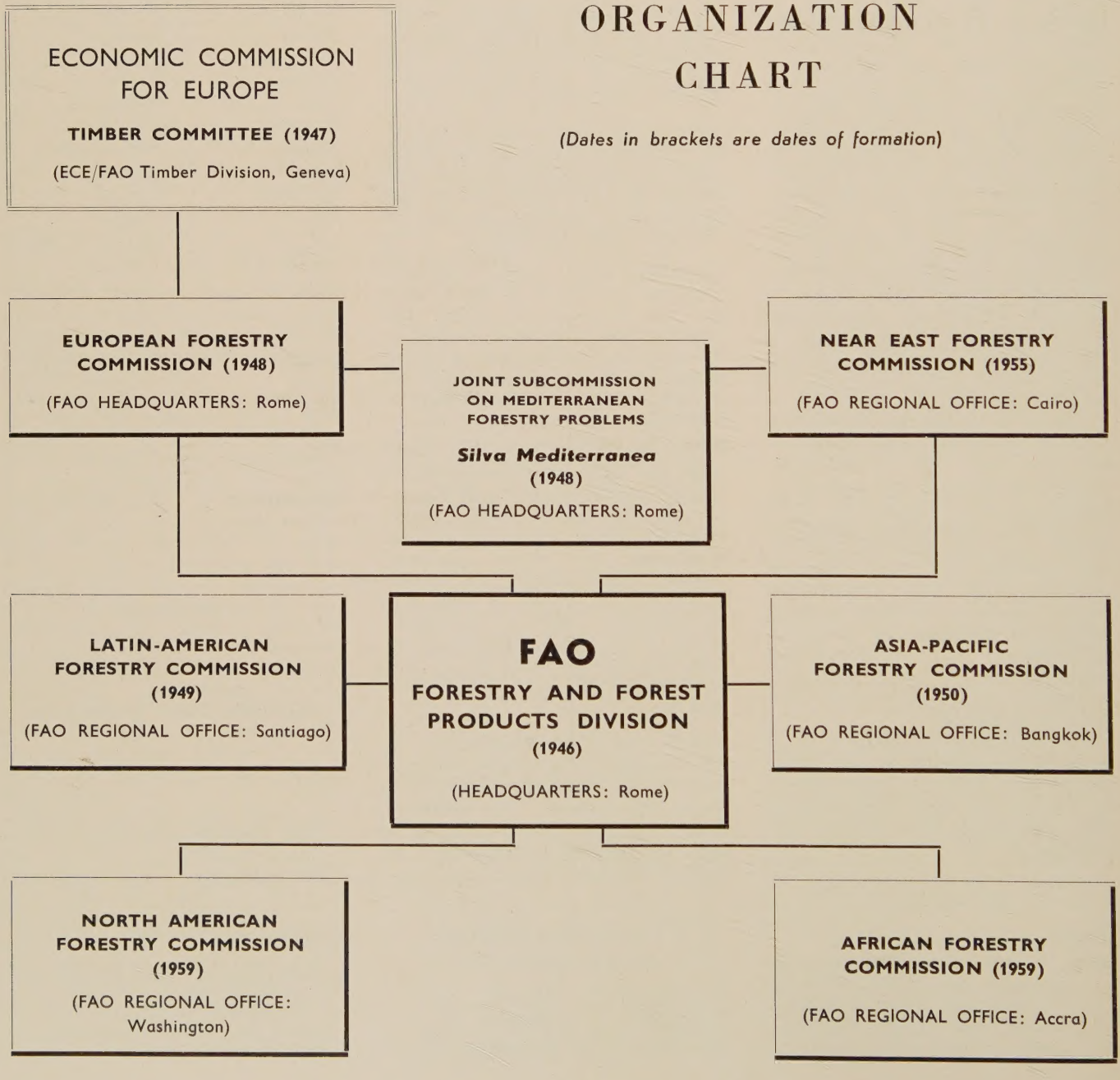
United Nations

FAO Geneva Office
Palais des Nations
Geneva, Switzerland

FAO Liaison Office
Room 2258, United Nations Headquarters
42nd Street and First Avenue
New York 17, N.Y., U.S.A.

ORGANIZATION CHART

(Dates in brackets are dates of formation)



FAO FORESTRY DEVELOPMENT PAPERS

No. 4. Handling Forest Tree Seed — **$ 1.00 or 5s.**
by H. J. Baldwin. 1955, ix + 41 pp. (E F S)

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